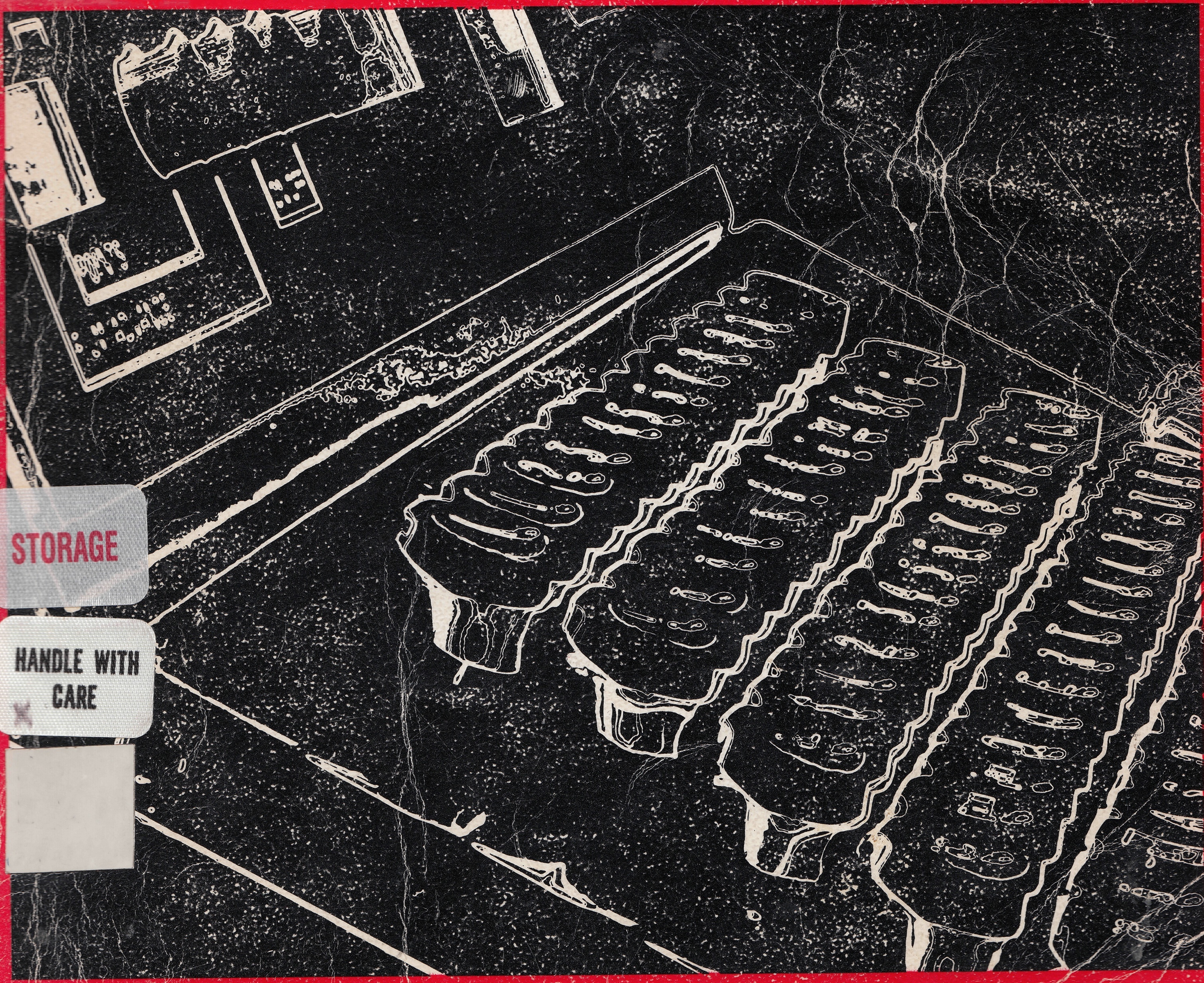
Handbook of Composition Input

Frank J. Romano
and the
Editors of American Press Magazine
In cooperation with
National Composition Association, P.I.A.



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by
Frank J. Romano

Produced in conjunction with the editors of American Press Magazine and the National Composition Association section of Printing Industries of America.

NCA®

National Composition Association

Section of PIA Printing Industries of America, Inc.

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Table of contents

Chapters 2,3, 6 and 7 are followed by a detailed
list of available devices and their associated specifications.

This book is dedicated to the memory of Arthur L. Koop, Jr., Manager of Advertising and Sales Promotion for Mergenthaler Linotype Company.
Thanks Art.

The bulk of typesetting for this book was done on Photon 713-5 phototypesetters using the Warlock Random Access Composition Entry system for input. The card medium (covered in Chapter 5) permitted the same kind of correction flexibility that would have been available in hot metal slugs. The author wishes to thank Warlock, its president, Ernest Griesbach, and especially its pretty and efficient keyboard operators. It is also with great appreciation that thanks are extended to the many manufacturers that provided information and assistance; and also to Roy Mochi, and to Don Goldman.

Early in 1926, Walter W. Morey suggested that equipment could be developed for automatic operation of linecasting machines from one or more remote points. This suggestion was discussed with Frank E. Gannett, owner of a chain of newspapers in the eastern U.S.

Later that year, Gannett and Morey discussed this matter with Sterling Morton, Howard Krum, and Edward Kleinschmidt, owners of what was then the Morkrum-Kleinschmidt Corporation, which manufactured most of the wire communication equipment in this country. The name of this corporation was later changed to the Teletype Corporation. After several conferences, it was agreed that Teletype would manufacture the equipment developed by Morey.

In 1927, a Teletypesetter Perforator was ready - based on the principles used in the six-unit perforator then manufactured for communication purposes. The equipment was tried at the McCarty Typesetting Company in Chicago, and during the first day fifty five lines were set covering the Lindbergh flight to Paris.

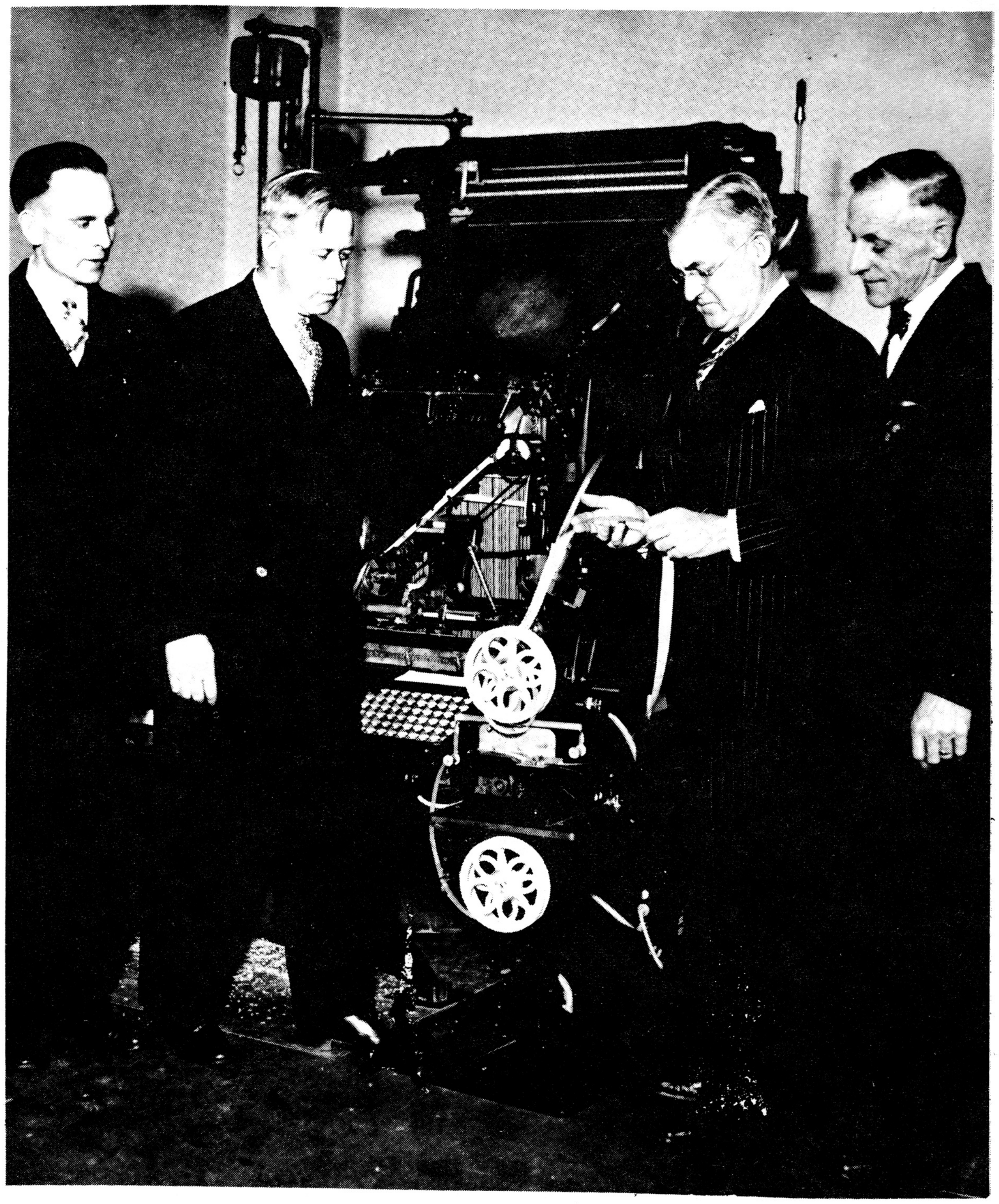
By 1928, the equipment was considered sufficiently well developed for preliminary unveiling to the field. Accordingly, a demonstration was arranged on the top floor of the Rochester Times Union Building (see photo to right).

During 1929, a separate corporation was organized under the name of the Teletypesetter Corporation to handle this type of business, and from then to 1930 an experimental installation was made at the Evanston (Illinois) News Index.

Manufacture of equipment was curtailed during the war. By 1951 the press associations began transmitting justified tape to newspapers and after one year about 400 daily newspapers were using this service.

The use of Teletypesetter grew at a rapid pace. In 1958 Fairchild Graphic Equipment purchased the business of Teletypesetter and in 1964 reported that over 1200 daily newspapers, 400 weekly newspapers and 350 commercial shops were using its tape equipment.

In use today, there are about 15,000 Perforators and 12,000 Operating Units. In 1972 Fairchild was sold to the Varityper division of Addressograph Multigraph. Below are two new versions of what began way back in 1926 when one man had an idea - an idea and an accomplishment that has to be considered one of the milestones in the progress of the graphic arts industry.



1. In the beginning

Over four hundred years passed before Gutenberg's movable type moved by machine rather than by hand. Even as late as the last decade of the Nineteenth Century and the tail-end of the Industrial Revolution a newspaper compositor set type almost the same way a Fifteenth Century printer did. From a large case in front of him he selected the necessary letters, numbers and other characters to form the line of type and then filled out the line with spaces to the required width. He did this over and over again for every line. A good worker could zip along at about 40 of today's newspaper lines *an hour*.

The development of the Linotype is a unique story all its own and this is not the place to retell it. Suffice it to say that Ottmar Mergenthaler, after several false starts, decided not to use foundry (or handset) type but rather to cast an entire line from matrices. One of his major problems was the automatic justification of the line of type which was solved by the sliding wedge or spaceband patent he obtained from J. W. Schuckers. Typesetters, on the average, set type by machine six times faster than by hand. Employers, hard-nosed businessmen that they were even then, sought to increase this profitability by utilizing unskilled operators, preferably women. However, the unions and experience showed that re-trained hand compositors were more appropriate. An active Fem-Lib movement in 1900 could have caused a different kind of revolution in the composing room.

In 1887 Rolbert E. Lanston unveiled the Monotype. Although constructed differently in many ways from the Linotype, its major difference involved the *non-direct* operation of the machine. A perforated tape was prepared on one unit, and then run on another to cast the characters. Corrections were made without re-setting an entire line as with the Linotype. It is interesting to note, with 20-20 hindsight, that tape typesetting was born at the same time the Linotype was.

In 1928 Walter Morey, a Monotype operator, invented the Teletypesetter. He experimented with tape as the typesetting medium to run a specially adapted Linotype, applying the principles of the Monotype to the dominant typesetting device of the day.

Typists, with minimal training, could produce tapes, which when fed into the Linotypes, produced metal slugs as though an operator was at the keyboard. In 1951 the Associated Press announced its TTS service and a year later United Press did the same. News now came into a newspaper as a tape which could activate a Linotype to produce type automatically. ***Billboard,*** a weekly newspaper, that year signed the first TTS union contract, outlining plans for perforation of tapes in New York for transmission by wire to its midwestern composing room. By 1953 almost 700 daily newspapers utilized TTS equipment, totalling about 1,400 keyboards for "punching" tape and about 1,500 units for feeding tape to the Linotypes.

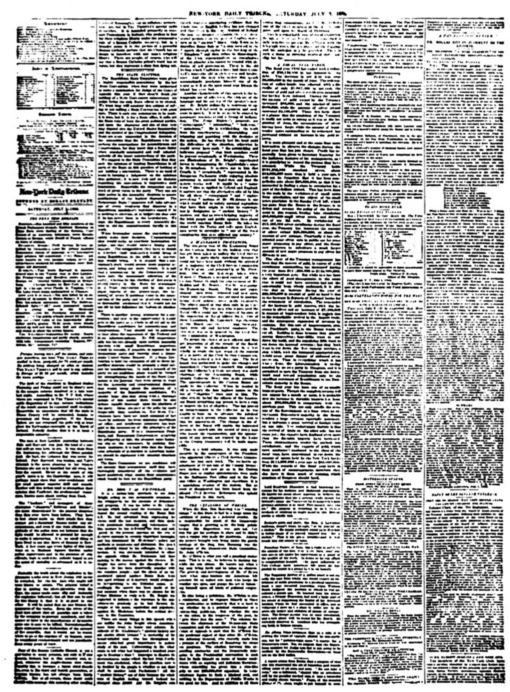
Teletypesetter Corporation promoted its system by saying that a beginning typist could produce 400 or more lines of type an hour. In 1958 Fairchild Graphic Equipment, Inc. purchased the assets of Teletypesetter and introduced new models which offered greater type mixing capability and other productivity features. In 1971 it was reported that over 15,000 TTS keyboards were built, with many still in use.

Since Linotype operators required retraining to use a TTS keyboard, union schools were established. The ITU even developed the Brewer Keyboard, invented by Claire N. Brewer, which was essentially a Linotype Keyboard designed to fit over a TTS keyboard. The operator now punched tape on a familiar keyboard arrangement.

Operating a TTS keyboard was more fatiguing than typing. There were nineteen additional keys over the normal typewriter set; the operator had to move his eyes from copy to pointer regularly to monitor justification, plus scan the tape for possible errors. In spite of this, the major advantage of tape operation was not at the keyboard (at this point in time) but in the efficiency of Linotype operation. Three Linotypes running from tape could produce as much type as seven Linotypists. By 1959, almost 1,200 newspapers had installed TTS equipment.

A woodcut of Mergenthaler demonstrating his new machine. Whitelaw Reid (right) of the New York Tribune named the Linotype.

The greater portion of this editorial page was composed on the first commercial Linotype placed in a Newspaper Plant. It revolutionized composing room methods and made possible the great Newspapers of today.



N. Y. Tribune Editorial Page, July 3, 1886

The first newspaper page set on the Linotype.

To convert the typesetting process from hand to machine a number of developments were necessary. The most important, and basic principle on which the linecaster rests, was that of producing lines of type to the *same width.* This was solved by the spaceband, a wedge-shaped device that expanded the space between words and forced each line to its maximum width. The spaceband was (and still is) a mechanical device with minimum and maximum expansion values; whereas in future systems the function of the spaceband would be (and was) imitated arithmetically.

The Monotype System introduced tape operation long before the advent of TTS. Consisting of two units, the keyboard and the caster, Monotype computes what the linotype expanded. Like any successful system, Monotype rests on a basic principle. In this case it is the Monotype unit system. First of all, it is necessary to understand the steps that lead to justification of a line of type:

1. The width value of every character is added, plus a minimum value for each word space.

2. The resulting total from (1) is subtracted from the pre-determined line length.

3. The number of word spaces is counted and this total is divided into the remainder left from (2).

4. The amount of space determined by (3) is inserted at each word space.

5. The line now equals the required measure.

In formula form:

$$\frac{\text{Total line length } \textit{less} \text{ Total of characters and spaces}}{\text{Number of word spaces}} = \text{Individual word space amount needed to space line out to measure}$$

Character allotment in an eighteen unit proportional spacing system.

Unit width	Characters
6	i l . , ' -
7	j f t
8	I
9	r s z ( ) 1 2 3 4 5 6 7 8 9 0 $; : !
10	c e o
11	a b d g h n p q u v x y k J S
12	Z
13	C T L
14	A B F O P & Q V
15	w D E G R U X Y H K N
18	m M W %

Each unit is exactly 1/18th of the width of the capital letter "M"

Thus it is extremely important that the width value of every character is known. This is the purpose of the unit system, a method that will be reincarnated in future tape operation.

Monotype matrices were designed with a maximum value of 18 units. This is a relative measurement, not an actual width value. The "W", "M" and other characters are allotted the maximum of 18 units. Here is a chart indicating characters segregated according to a unit system. Designers may vary characters to fit a different unit value; thus, not all letters always occupy the same unit value, *but* all must fit into one of the established unit categories.

As the Monotype Keyboard operator punched the special tape for activation of the caster, a mechanical wheel "added" the unit values of each character and space in a line. Word spaces per line were also counted and indication made of the need for an end-of-line decision. A scale informed the operator which keys were to be struck to obtain the correct word space width. The resultant tape was then fed into the caster tail-end first so that the spaces would be cast first.

Impetus for the development of tape-run linecasting came in the 1930's with the growth of newspaper groups and chains. The ability to share tapes among several papers, since certain types of articles of news were produced word for word in many different locations, seemed to be an answer to the problems of composition productivity. The existence of the nationwide Teletype communications system added fuel to the tape-selling fire. In 1933 Walter Morey introduced Teletypesetter and the ability to input copy a single time on tape and transmit it to various locations by telegraphic methods.

Tape perforation was a whole new ballgame. It was unlike linecasting; its keyboard was a standard "QWERTY" one type rather than the Linotype's "ETAOIN," and instead of monitoring the assembly of matrices, the operator monitored a width accumulation pointer to make the necessary end-of-line decisions. Since computational functions as to the number of characters, number of spacebands and their minimum width values were performed at the keyboard, the tape replaced the linecasting operator but continued to perform all of the linecaster's functions.

TTS was a transmission system in its original form. Tape generated at a central location was transmitted by wire to another location. There a duplicate tape was produced on a Reperforator. Linecasters were equipped with the Operating Units to read the tape and Adaptors to replace the keyboard.

The TTS Perforator had a standard typewriter layout with the exception of the SHIFT key which did not work like a standard typewriter SHIFT key. To access a capital letter the operator hit SHIFT, then the character, and then UNSHIFT in order to return to the lower case. An important part of the Perforator was the counting mechanism, which accumulated (added) character and space values. TTS required a unit system somewhat similar to the Monotype Linecasting System. Matrices were made according to values established by dividing the EM space into eighteen parts. Eleven groups of width values, starting at 6 units (the narrowest) and going to 18 units (the widest), were used to divide up a font.

The TTS Perforator produced no hard copy (that is, no typewritten end product). It was among the first "blind" keyboards and its only function was to create proper input tapes for a linecaster. The operator observed the scale in front of him and made end-of-line decisions (hyphenation, etc.) when the pointer entered the justification zone. Other keys on the perforator controlled linecaster machine functions.

Since the unit system restricted TTS to newspapers, another version of the

perforator was developed to count non-unit matrices. The Multiface Perforator, as it was called, could handle those typefaces designed on a 32 unit system. The EM was divided into 32 units with 5/32 of the EM as the narrowest character. There were 28 groups of width values.

Because all typefaces vary in the widths of their characters, especially in fonts of different point sizes, TTS had to solve the problem of mixing. The answer came in the form of a width encoder, called a Counting Magazine by TTS, which recorded the width values for all characters in a particular typeface. From unit cut, to non-unit cut, to mixing, Teletypesetter evolved into a broadbased tape system for automatic linecaster operation.

Photographic typesetting enters the picture

There are differing opinions as to the birthday, and the father, of photographic typesetting. Practically, as well as diplomatically, there were several of both. In 1944 an ITT engineer in France named Rene A. Higonnet visited an offset printing plant in Lyon and observed the difficulty of adapting hot metal composition to the photo-lithographic process. Recalling a technical paper on the use of flash tubes to study high speed mechanisms such as propellers, he discussed an application of this principle with a friend, Louis Moyroud. By 1945 they had put together a simple machine to demonstrate that a flash was fast enough to project on a plate a clear image of a character from a revolving disc. The second problem, line justification, was solved by April 1946 in a unit that composed lines on film from a selection of 82 characters. The main components of the machine were:

In 1968 the direct input concept rose from the ashes in the form of Compugraphic's 7200 display phototypesetter. It produced type from 14 to 72 point in any of four typefaces all under direct operator control.

a. A manual typewriter with permutation bars and contacts to give each character a unique binary code.
b. A memory register to record the codes on a revolving drum. Solenoid-controlled pins could be set for either of two positions.
c. A counter-justifier to accumulate character widths and determine word space increments after each line had been typed.
d. Control circuitry composed of telephone relays (ITT, remember?)
e. A photographic unit made up of a film carriage and a continuously rotating disc with 82 clear characters on a black background (a photo positive).

In May, 1946 Higonnet visited the U.S. and, attempting to interest investors, found his way to William W. Garth, Jr., President of Lithomat Corporation developers of lithographic plate materials. An agreement was reached and a second version was demonstrated in July 1948. This unit offered 88 characters, improved speed, and one of the first electric typewriters, an Electromatic. A variable escapement mechanism permitted a selection of 18 character widths. In 1949 the machine was shown to the industry.

This is the Photon 200B. It was the first true photographic typesetter to be introduced commercially. Like the Linotype it was controlled directly by the operator, who, sitting at the keyboard, could set sixteen typefaces in twelve type sizes in a variety of typographic formats up to 72 points. Whether composition should be produced directly or indirectly (off-line tape) is still an area of concern to those who set type.

In September, 1950, at the Chicago-held Graphic Arts Exposition, Intertype unveiled the Fotosetter, a machine that composed type on film or photosensitive paper, instead of hot metal slugs. To the naked eye the Fotosetter was a linecaster, except that the pot of molten lead was replaced by camera equipment. It contained 114 instead of 90 keys and used a matrix very similar in outward appearance to the casting matrix, again with the important exception of a photo-negative character embedded in its side. Characters could be enlarged or reduced from 6 to 36 point in a number of sizes in-between from the 12 point Fotomat at the turn of a dial. Complicated mixing of sizes and typefaces was greatly simplified over the hot process where a separate magazine was necessary for each size in each typeface. Mergenthaler, at this exhibition, showed an aborted version of the Linotype that used ebonite matrices (the line was set and the characters photographed). Linofilm, as it was called, went back to the drawing boards.

The Fotosetter and the Higonnet-Moyroud machine continued the direct operation concept of the linecaster.

Meanwhile back at the H-M unit, development continued. It was decided that the machine would operate from a standard typewriter keyboard, and that all controls should be at the keyboard position. Other decisions: justification should be from one typing, line lengths up to 42 picas (Linotypes used a standard 30 picas; 42 pica units were more money), line length should be under dial control; typefaces should be mixed in the same line, as well as type sizes, lines should be able to be "Killed", and all quadding functions should be automatic. They were far from achieving these goals. So more money was raised and Lithomat changed its name to Photon.

By 1955 ten machines had been installed. Time for development of the expanded unit allowed time for other competing units to reach fruition. The Linofilm from Mergenthaler (now a true photographic device using a grid for master images) and the Monophoto from Monotype were announced. The Photon unit was way ahead in terms of capability, offering sixteen fonts in twelve different sizes. In late 1955 further improvements were made and the 200 series machines were introduced.

The year 1956 saw the following inventory of industry phototypesetting devices:

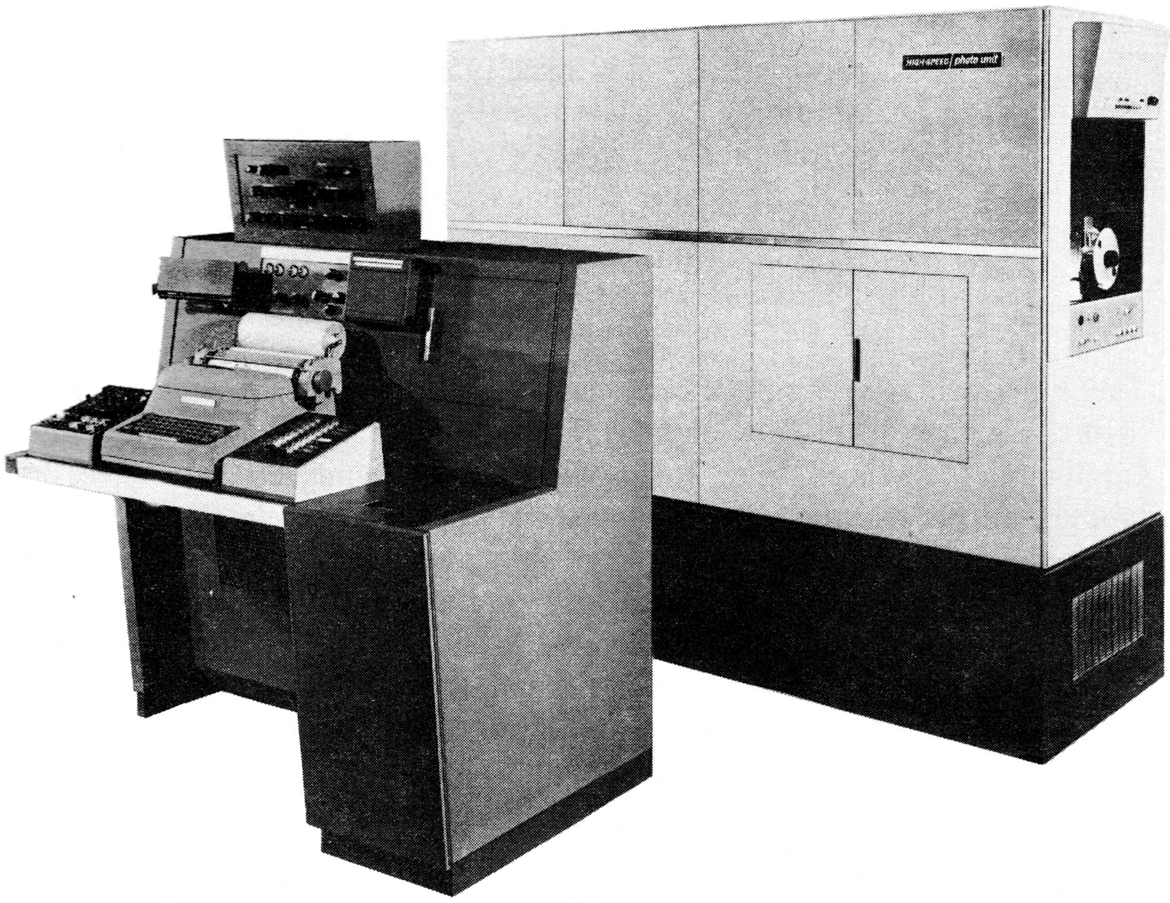
Fotosetter	250 since 1950	about $33,000 each
Photon	62 since 1950	about $55,000 each
Monophoto	6 since 1955	about $35,000 each
Linofilm	2 since 1955	about $57,000 for one keyboard , one photo unit
ATF	31 since 1954	about $14,000 each

The American Type Founders unit incorporated the Flexowriter keyboard to prepare tape to drive a photographic output unit. In 1951 the Friden Company introduced the Justowriter, a two-unit direct impression typesetting system. An operator typed his copy on one electric typewriter (Recorder) perforating a 7-level paper tape, at the same time. Codes on the tape for characters and justification were needed for the output unit (Reproducer) which typed justified lines. ATF replaced the output unit with a true photographic, instead of strike-on, device. The Monophoto unit retained the tape principle used in its casting units. Linofilm also advocated the separation of keyboarding and photographing.

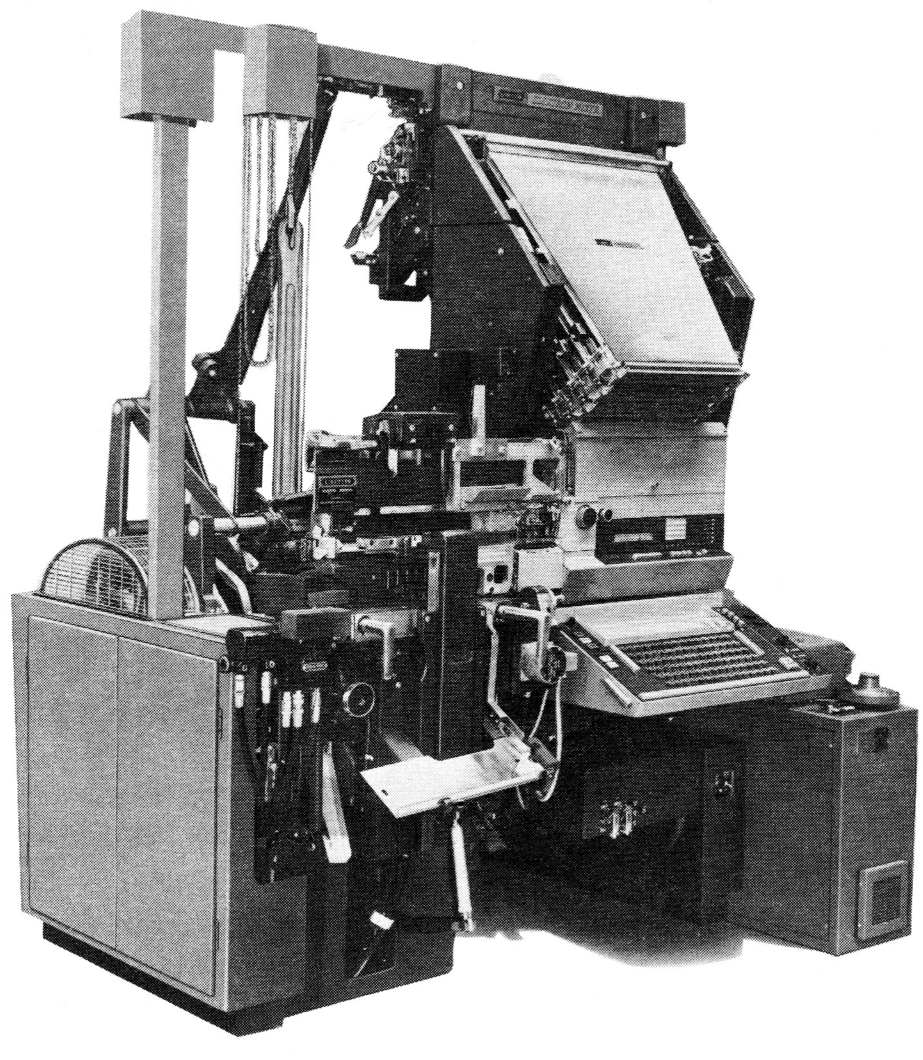
Aware of the tremendous growth in the use of punched-tape from about 1950 to 1960, Photon decided to develop a tape capability into the 200 series machine. Two models were planned; one to accept TTS tape (the 510 series) and one to accept Monotype tape (the 520 series). Of course, users were restricted in accessing all capabilities of the Photon photo unit because of the inherent limitations of the TTS and Monotype code structures. To solve this problem and better meet the competition of the multiple keyboards to one photo unit concept, a new series was begun. The 540 series used the photo unit and keyboard from the 200 series but separated them. In December 1962, 12 photo units and 5 keyboards were shipped. The keyboards perforated 8-channel paper tape.

By 1964 new photographic typesetters were being readied. Between then and 1967, the Linofilm Quick, Fairchild Phototextsetters, Photon 713 series and Intertype Fototronic were introduced. Most accepted 6-level TTS paper tape, by now the dominant input medium. In 1968 Compugraphic Corporation introduced the forerunners of a phototypesetting line priced below all others in the industry. TTS tape was the input. Many (and that means *many)* other phototypesetters were introduced between 1968 and the present. A survey of them and their capabilities is included later in this book.

As can be seen, typesetting and input evolved along parallel, but separate paths.



Mergenthaler's Linofilm was introduced shortly after the Photon 200B. It separated the functions of keyboarding and output and was the first true phototypesetter to demonstrate the principle. Two to three keyboard operators could keep one photo unit busy.



The Elektron was Mergenthaler's new breed of Linotype in the early sixties. It was designed specifically for tape operation and could zip along at fifteen newspaper lines per minute. The Intertype Monarch was also designed specifically for tape, and, in fact, was introduced and sold without a keyboard.

2. Telling a typesetter what to do

There was a time when typesetting meant only the process of assembling individual pieces of type by hand. Gutenberg printed his Bible from movable type in the middle of the Fifteenth Century in this way. The first major advance in typesetting came centuries later with the invention of the casting typesetters. Another major advance in typesetting occurred effectively within the last five years with the development of photographic typesetters.

Typesetting cannot be easily discussed without reference to hand typesetting and to the operations of Linotype and Monotype machines. This is so because many terms used in typesetting have no literal significance except with respect to the earlier processes — since it was with these earlier processes that the terms originated.

It is the purpose of this section to present some basic facts about type composition. All of the important terms will be introduced.

An understanding of typesetting requires having at least an elementary knowledge of typography. The most basic element of this knowledge is in knowing what the various printing characters are called.

Printing characters

In the English alphabet there are twenty-six letters with which words are formed. Each letter appears in several kinds of printing characters: ***upper case letters, lower case letters, small capitals, initial letters, ligatures, and logotypes.***

Upper case letters are called *capital* letters since they are used for satisfying the rules of grammar which requires that the first letter in every sentence be a capital and that proper names be capitalized.

The terms *upper case* and *lower case* are derived from the arrangement of cases used by printers for holding type. Capital letters are distributed in the upper case; hence, the term upper case letters.

Small capitals are similar to upper case letters but are designed somewhat differently in order to form entirely capitalized words having a pleasing appearance. The height of small capitals is always somewhat reduced from that of upper case letters.

Initial letters are ornamental or large capital letters used to embellish composition.

A *ligature* is formed by combining two or more letters into a unique design. Early printers, following the practices of the scribes, had many more ligatures than is now customary. In book composition and in many periodicals, but not newspapers, the f-ligatures are common.

Ligatures for the dipthongs ae and oe are familiar printing characters for both upper and lower case letters and for small capitals.

A *logotype*, defined with respect to handset type and Monotype, is a combination of printing characters cast from a common matrix. The simplest kind of logotype is a combination of letters spaced in a way that is not possible with ordinary type. For example, the italic letters *Y* and *e* spaced according to the physical requirements of ordinary type result in an unattractive gap; the same letters, with improved spacing, look much better as a logotype. Because there is no inherent limitation in photographic typesetting in achieving any desired spacing, the provision for generating logotypes is simplified. Modern phototypesetters utilize a "kern" command to "back up" and tuck characters together.

Many logotypes are distinctive combinations of letters and other printing characters. Ligatures can be included within the definition of a logotype.

Accented letters are part of many alphabets: French, German, Italian, Spanish, any foreign language.

Figure is the term used by printers when referring to the numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. There are two distinct classes of figures. Modern figures are designed to have a uniform height and sit on the base line of the alphabet to which it belongs. Old style figures are designed so that some figures descend below the base line and the figures do not all have the same height.

Fractions are closely associated with figures. An extensive variety of fractions is available in type.

Points, or the marks of punctuation include the following:

, Comma

; Semi-colon

: Colon

— Dash

Hyphen

‘ Beginning quotation marks

’ Ending quotation marks

[Beginning brackets
] Ending brackets
(Beginning parenthesis
. Period
? Question Mark
! Exclamation Point
) Ending parenthesis

The quotation marks are used simply or doubly. The apostrophe is of course identical as a printing character to a single ending quotation mark.

The ampersand is a mark which represents the word *and*. There are common and italic forms of the ampersand.

The *marks of reference* include the following:

*	Asterisk
†	Dagger
‡	Double Dagger
§	Double-S

The *paragraph mark* can take many forms.

The following *commercial* and *monetary* signs are familiar printing characters:

%	Per Cent
lb	Pound
#	Number
c/o	Care Of
$	Dollar
£	Sterling

Superior and inferior characters include both letters and figures and are used in mathematical work. Superior figures are used to denote references in scholarly texts.

Special characters are used in printed matter for a wide variety of purposes: ornamental devices, arrows, astronomical marks, mathematical symbols, ecclesiastical signs, musical notations, bullets, ballot boxes, etc.

Horizontal and vertical rules are used to form tables. A careful examination will show that each vertical line is composed from a series of short rules.

Leaders are dots used in many types of composition, such as telephone directory listings.

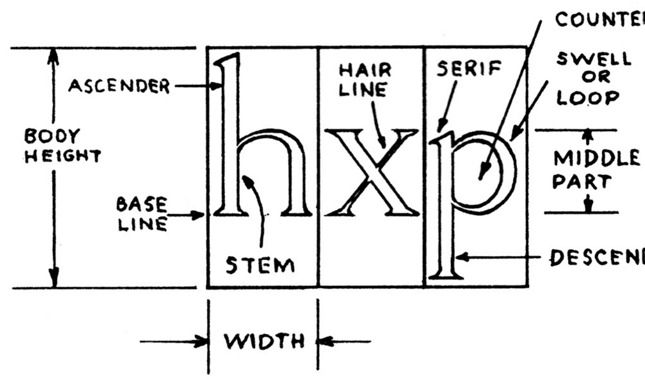
An EM leader has two dots; an EN leader has one dot.

The term *typeface* originated with hand typesetting. A typeface is the flat

surface at the top of a piece of type; when subsequently inked and pressed against paper, an impression of the printing character is obtained. The face is thus a reverse image of the printing character.

The term *face* has broad significance in that it is used in describing styles of type. Thus one can generalize about bold face types or become specific and refer to Caslon Old Face.

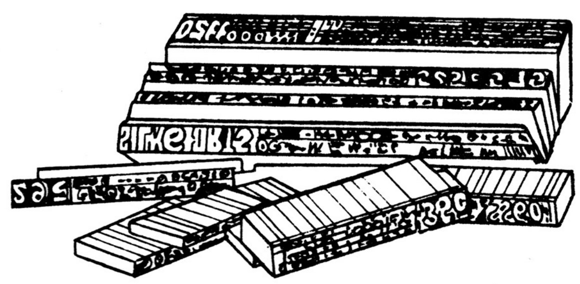
A typeface may have a number of features which have an effect on spacing and on how well characters are reproduced. A *stem* is a thick vertical line used in forming a letter; a *hair line* is a thin one. Some letters consist only of straight lines and others, like the *p* consist also of *loops* or *swells*. A *counter* is a space surrounded by lines. A *serif* is a short cross-line at the extremity of a letter and is one of the most important characteristics of type style. Sans serif characters have no serifs.



The *middle parts* of letters used in the same composition must all sit on a common *base line*. The part of a letter that drops below the base line is called a *descender*; the part that rises above the middle part is called an ascender. The entire vertical distance in which a type face is to be located is called the body height. The corresponding horizontal distance is called the *width*.

The face of a piece of hand-set type is produced by casting. A *matrix* for the face is inserted into a mold. Molten metal is poured into the mold; the chief ingredient of the alloy is usually lead. Hand-set type is often referred to as *foundry type* because it is produced in foundries.

The term *matrix* is directly applicable to both Linotype and Monotype casting operation. A Monotype matrix is used to cast at a given time a single piece of type quite similar to foundry type. A Linotype matrix is also called a *mat*. Linotype matrices are assembled as shown in the figure at right and a complete line of type is then cast in the Linotype mold. The resulting line of type is called a *slug*.



Linotype lead slugs. The ability to access only a portion of typeset material for correction is one of the attributes of hot metal composition that photographic methods have been hard put to emulate.

Type is produced in photographic typesetting by projecting images onto photographic film or paper. Images are created by transmitting light through clear areas on an otherwise opaque film, drum, or disc. The characters formed by the clear areas may be called *font characters*. Font characters may also be generated using cathode ray tubes.

Font characters are analogous to the matrices of the type casting processes with an important exception. The correspondence between a matrix and the resulting typeface is one-to-one; however, the typeface produced from a font character need not be the same size as the font character. In the Compugraphic 7200 Phototypesetter, for example, a single font character can produce typefaces in eight different sizes by selecting from eight projection lenses.

Type measurements

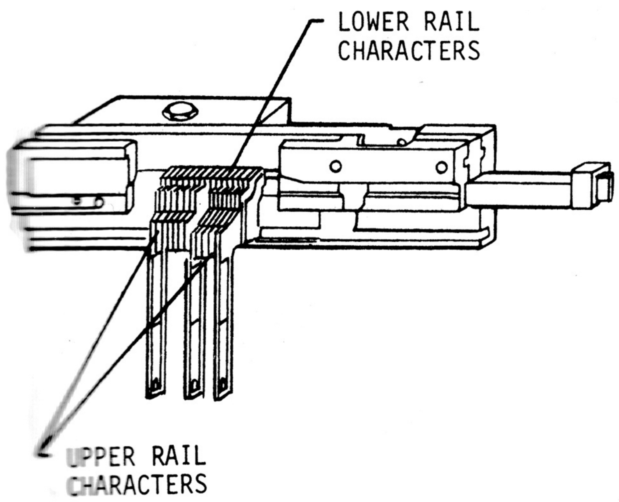
The height, width, and spacing of type is measured in *points* and *picas*. There are three principal point systems in use today. The *American-British System*

is in use in English speaking countries. The point in this system is 0.01383 inch; twelve points makes a pica. The *Didot System* is in use in France and in most countries of Continental Europe — but not in Belgium. The basic unit of the Didot System is called the *corps* or *point*; it has a value of 0.01483 inch. Twelve corps equal a *Cicero*. In the *Mediaan System* of Belgium, the corps or point has a value of 0.01324 inch; twelve of these equals a *Mediaan* and/or *Cicero*.

Two measurements determine the size of an individual piece of type. Referring back, these are the body height and width. For foundry and Monotype, the measurements can be made on an actual piece of type. Type produced photographically, however, does not have any apparent boundries; but the boundaries, nonetheless, are implicit. The artwork from which photographic characters is made is drawn within an area having an outline corresponding to the borders of an equivalent piece of foundry type.

When referring to a complete alphabet rather than to an individual piece of type, the alphabet size is defined by *body height* and *set*. Body height is always measured in points.

Point size always refers to the body height. Thus, 10-point Scotch Roman specifies a Scotch Roman type having a 10-point body height.



Matrices and spacebands assembled and ready for casting.

The width of an individual piece of foundry type is determined by the design of the printing character. For example, a 7-point lower case letter *i* would ordinarily be much narrower than a 7-point upper case *B* in the same alphabet.

The width allotted a Linotype face is the same as the width of the Linotype matrix. Since Linotype matrices are made from brass, the term brass width is often used to denote the width of a Linotype character.

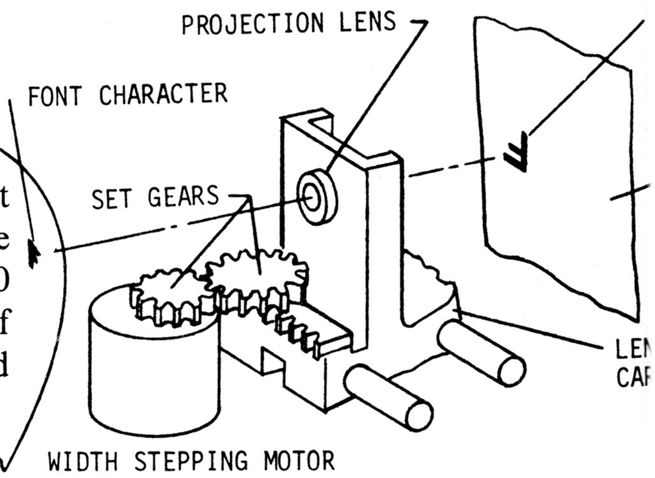
The set of an alphabet is a relative measure of the width of the entire alphabet. The em space is divided into a number of relative units (RU). The width in points of the em is the set of the alphabet. Every character in the alphabet is designed so that its width is an integral number of relative units. The actual width of a character in points is then

$$\frac{\text{RU in character}}{\text{RU in em}} \times \text{Set}$$

where set is in points. In most typesetters the alphabets are designed with an em having 18 relative units; Justowriter alphabets are designed with an em having 5 relative units.

For foundry type, an em is a square space having a width equal to the body height.

The body height of type produced on a phototypesetter is determined by the size of the font character and by the magnification of the lens used to project



an image of the font character. The Compugraphic 2900 and 4900 Text Phototypesetters have two lenses so that the type size is controlled by the size of the font character (same size lens) or twice size (2X lens). In the CG 7200 Headline Phototypesetter the font character is always 10 point. By means of eight projection lenses, type from 14 points to 72 points can be produced from the same 10 point font characters.

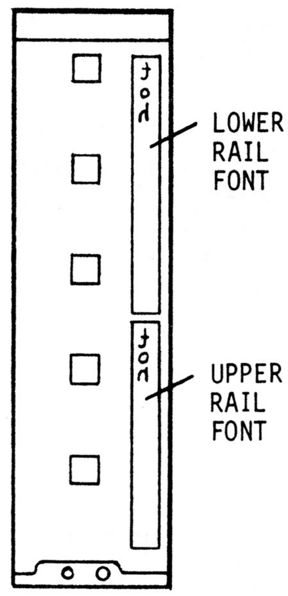
When a character has been photographed, the ***width stepping motor*** will take as many steps as there have been relative units assigned to the character. The motion of the width stepping motor is modified by the ***set gears*** in such a way that the lens carriage will move so that the optical axis of the system will shift an amount equal to the width of the type. Different sets are provided for by changing set gears.

Font & font strips

A font of type consists of an assortment of printing characters in a size and style. Thus, ***ten point Electra*** is the description of a particular font. The exact assortment of type in a font will vary somewhat depending on the requirements of composition.

A Standard Roman font includes upper and lower case letters, small capitals, figures, marks of punctuation and reference. Some fonts may contain ligatures or fractions, and others may not.

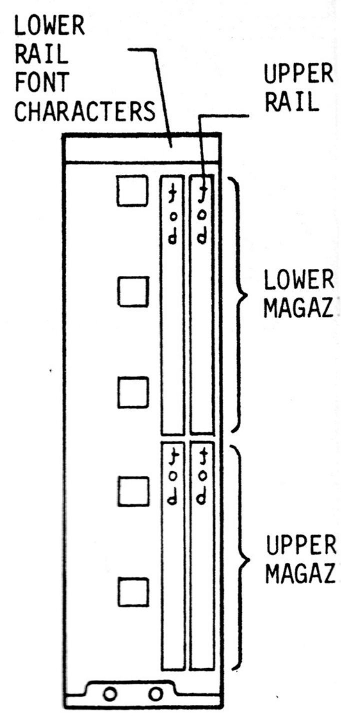
A two-font film strip. Upper half for lower rail; lower half for upper rail.



A font of foundry type is stored in the printers' cases. There is a separate partition for each character. A character for which there is no partition is called a pi character. When two different fonts of foundry type are used in the same composition, the compositor simply goes from one pair of printers' cases to another to collect the pieces of type required.

In Linotype operation, two or more fonts are available, depending on the capabilities of the particular machine in consideration. This is accomplished by two operations: the ***rail shift*** and the ***magazine shift***.

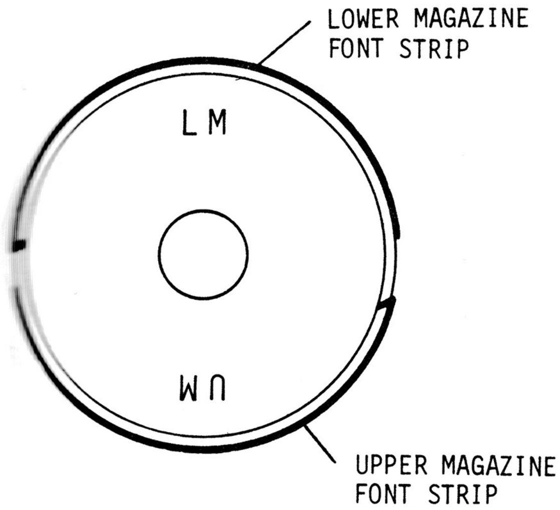
Some Linotype machines are equipped with two magazines — an ***upper magazine*** and a ***lower magazine***. Some Linotypes have as many as four magazines; these are usually designated as MAG-1, MAG-2, etc. Each magazine stores an assortment of ninety different matrices. A matrix that is not stored in a magazine is called a ***pi mat*** or ***pi matrix*** and is said to ***run pi***. Referring back to the figure of the Linotype matrix, it is seen that a Linotype matrix contains two different faces. When a matrix is assembled, either one or the other of the faces is aligned in the casting position. This is accomplished by the rail shift. A character is thus assembled in the ***lower rail position***, or ***upper rail position***. By means of the rail shift, companion faces can be composed in the same line.



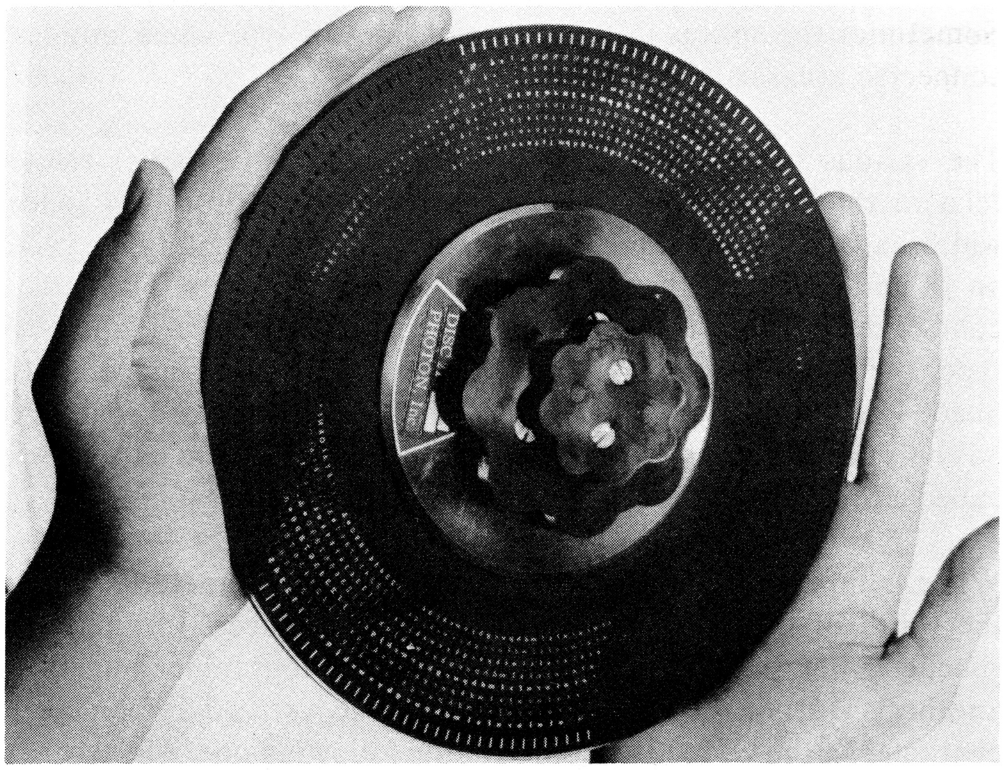
A four font film strip. Now the upper half is the lower magazine and the outside row the upper rail.

The concept of upper and lower rails, and upper and lower magazines is applied to the identification of the style choices available. A font strip for a CG 2900 Series Phototypesetter has a single track of characters. The first half of the font strip contains the ***lower rail*** style, and the second half the ***upper rail***. The font drum of a CG 7200 Phototypesetter can mount two

separate font strips. One font strip is mounted in the lower magazine (LM) position, and the other in the upper magazine (UM) position. In addition, each font strip has two tracks, one of which is designated as being in the lower rail, and the other in the upper.



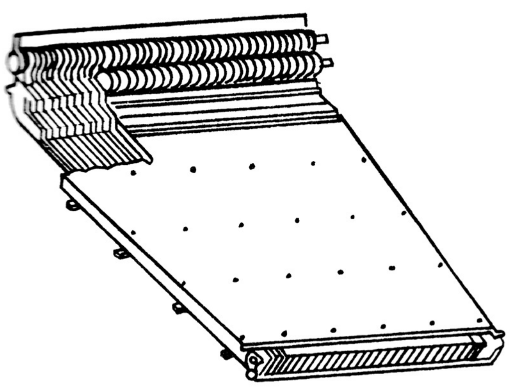
Film strips are mounted on drums with position nomenclature the same as that used on the linecaster.



The Photon glass matrix disc.

The term *composition* when applied to printed matter, means the selection of type by size and style, and its arrangement. Even a cursory survey of newspapers, books, circulars, calling cards, posters, and pamphlets will give some indication of the great variety possible with printed matter.

A linecasting magazine. It has 90 channels, each for a unique character - in one point size.

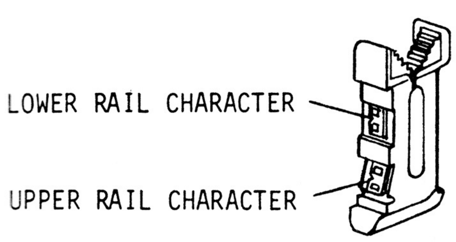


The size and style of type and its spacing are selected to satisfy readability and appearance. The general appearance of a column or page of type will create a distinctive light or dark appearance. This appearance is referred to as the *color* of type. In photographic type compositions color is determined not only by the selection of the face, but by the photographic process. The control of photographic density is thus very important in achieving good typography.

Straight matter is simple *justified* text.

Except for the paragraph indention of the first line, every line is flush with the *left margin*; except for the last line, every line is flush with the *right margin*. The length of a line is measured in picas and points. Type not flush with the left or right margin is *ragged*.

A line of foundry type is justified by filling the line with words; or, following the rules of hyphenation, by ending the line with part of a word and a hyphen.

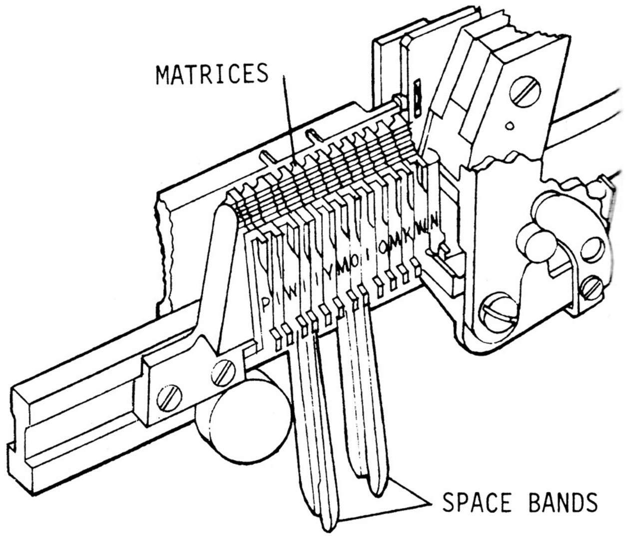


A linecasting matrix.

To fill out a line so that it is flush with the right margin, spaces are inserted between words called *interword spaces*. In Linotype composition, the interword spaces are filled out by inserting space bands between words. Space bands are double wedge devices that expand in thickness when mechanically acted upon.

In some cases it is necessary to add spaces between the letters of a word - a process known as *letterspacing*.

Justification in computer-controlled photographic typesetting is effected by calculation. The space required to fill a line is divided into the number of interword spaces and, if necessary, one or more words are letterspaced. Sometimes the spaces in a number of lines of type cause noticeable white-connected areas called *rivers*.



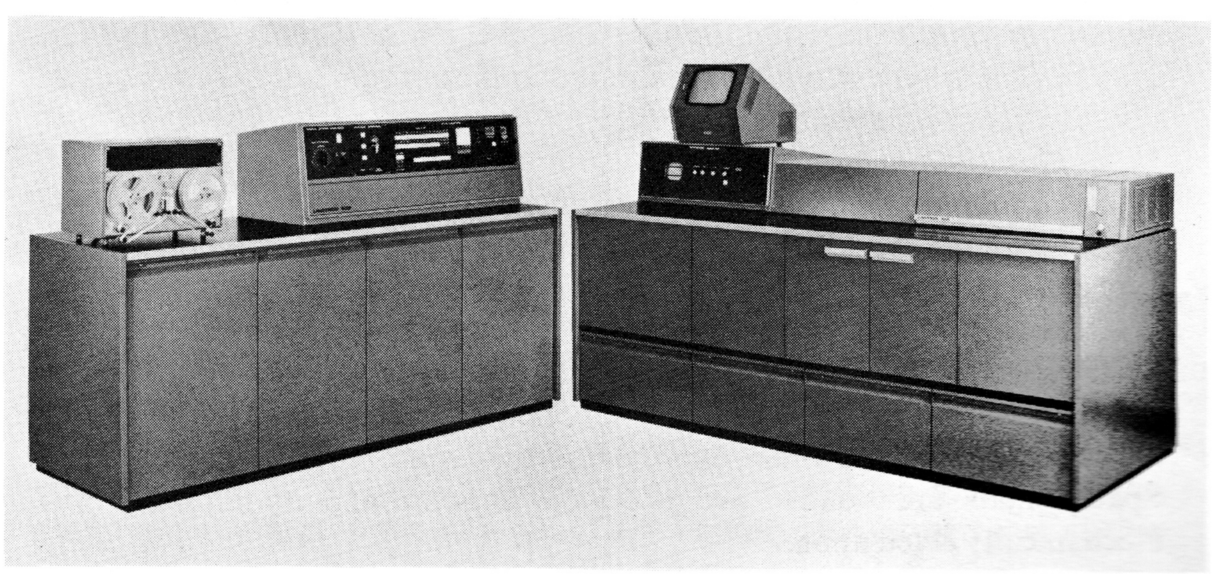
The spacebands are pushed up, or "expand" to fill the word spaces.

The various spaces used in composing a line have names related to their relative thickness. An em space in photocomposition is a space having a width based on the full number of units used in designing the type. Thus for an 18 unit alphabet, the em has eighteen relative units. The actual width, of course, depends on the set of the type as previously explained. In foundry type, the em is a square of the type body. A square space is also called a quad. The term quadding applies to filling out a line with space. An en space has half the thickness of an em space. The space used in letterspacing is often called a thin space or a hair space.

When composing foundry type, the spacing of characters is determined by the width of type and the use of additional spaces. In photocomposition, spacing is determined by the distance one photographic image is offset from another. This offset is measured from the vertical reference line of one character to the vertical reference of the following one. The term *escapement* is often applied to this width because some early phototypesetters used escapement mechanisms for obtaining character displacement.

In some composition it is desirable to place type closer together than is possible in the case of foundry type if kerning were not used. Kerning allows part of a character to extend into the body of an adjacent character. Kerning is, of course, easily accomplished in photographic typesetting.

The terms ***flush left, flush right,*** and ***center*** are used to describe unjustified lines flush with the left margin, the right margin and centered. Display composition, the type of composition used in advertisements, utilizes flush left, flush right, and centered lines. The term ***Quad*** is synonymous with ***Flush***).



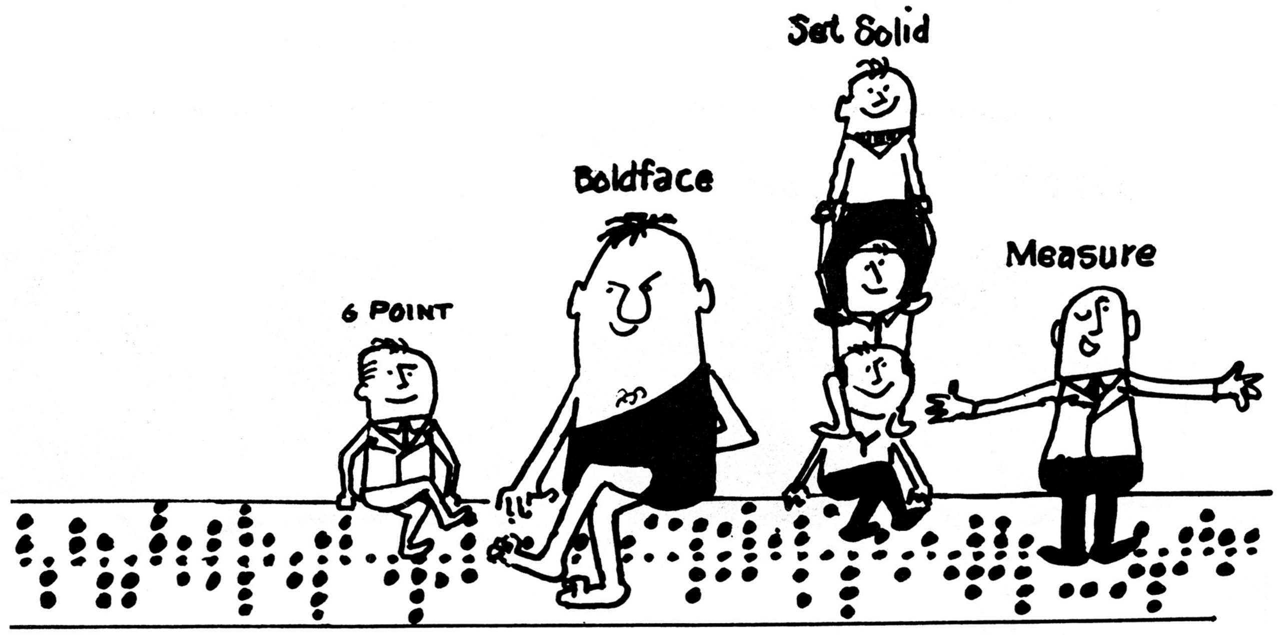
The Linotron 505 was introduced by Mergenthaler in late 1967. It utilizes a cathode ray tube (CRT) for composition and originally required input via a computer. The present version, 505C, has its own computer and can thus accept unjustified tape. Mergenthaler has a special keyboard designed specifically for the 505.

The space between lines of type is controlled in foundry type by the body height of the type and by the addition of leading between lines. Leading is strips of lead, hence the term. In photographic type composition, the spacing is determined by the amount by which the base line of a line of type is displaced from the baseline of the preceding line. The term *leading* when applied to photocomposition means the displacement of lines of type. Leading is usually measured in points.

Justification

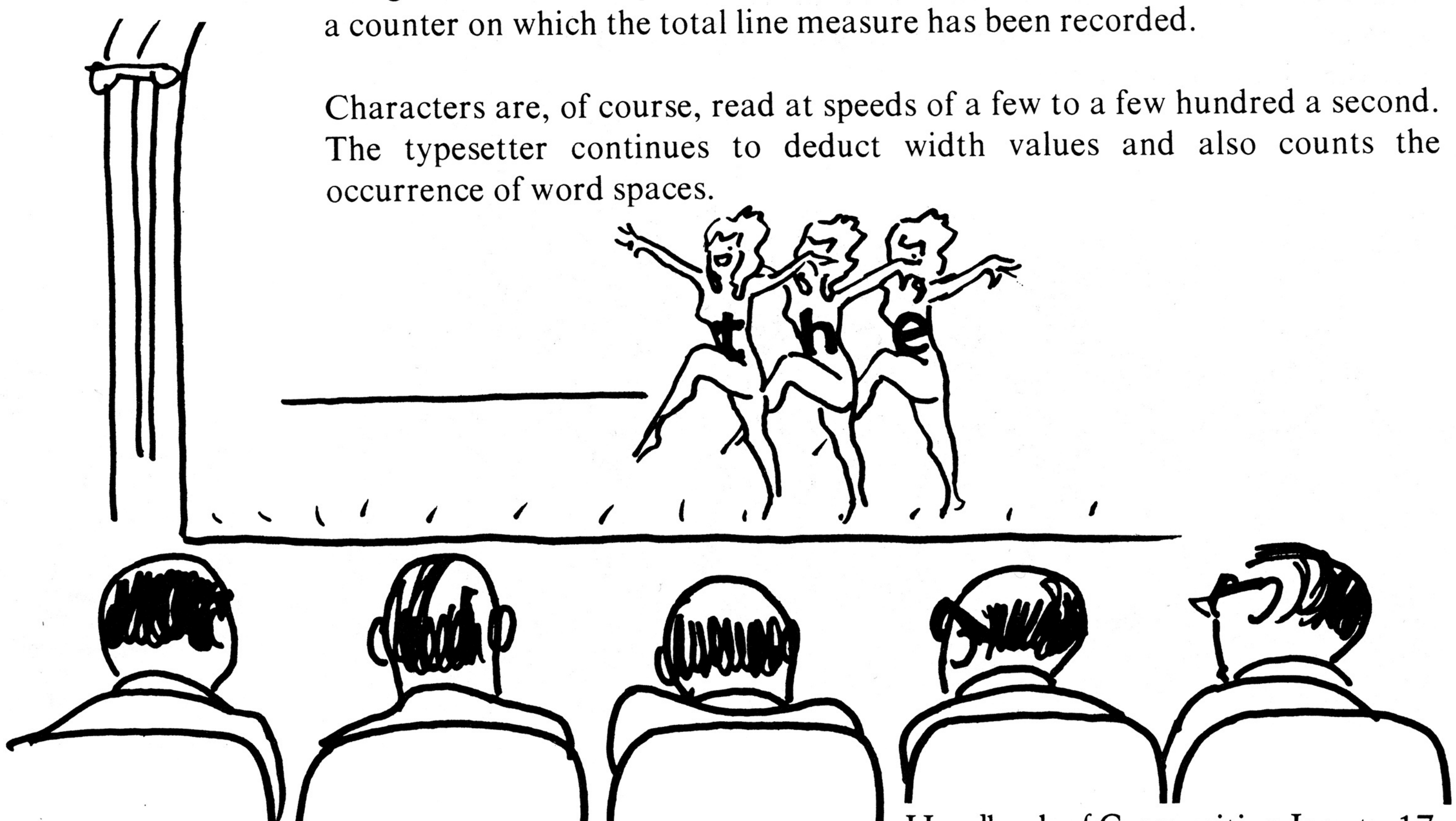
Here's how a line of type is justified in a "computer" system or stand-alone typesetter with "computer" capability:

All typesetting starts with *initialization.* One must define the parameters and format of the material to be set in type: point size, type style, leading, and line measure. This is also called "dressing" the typesetter.

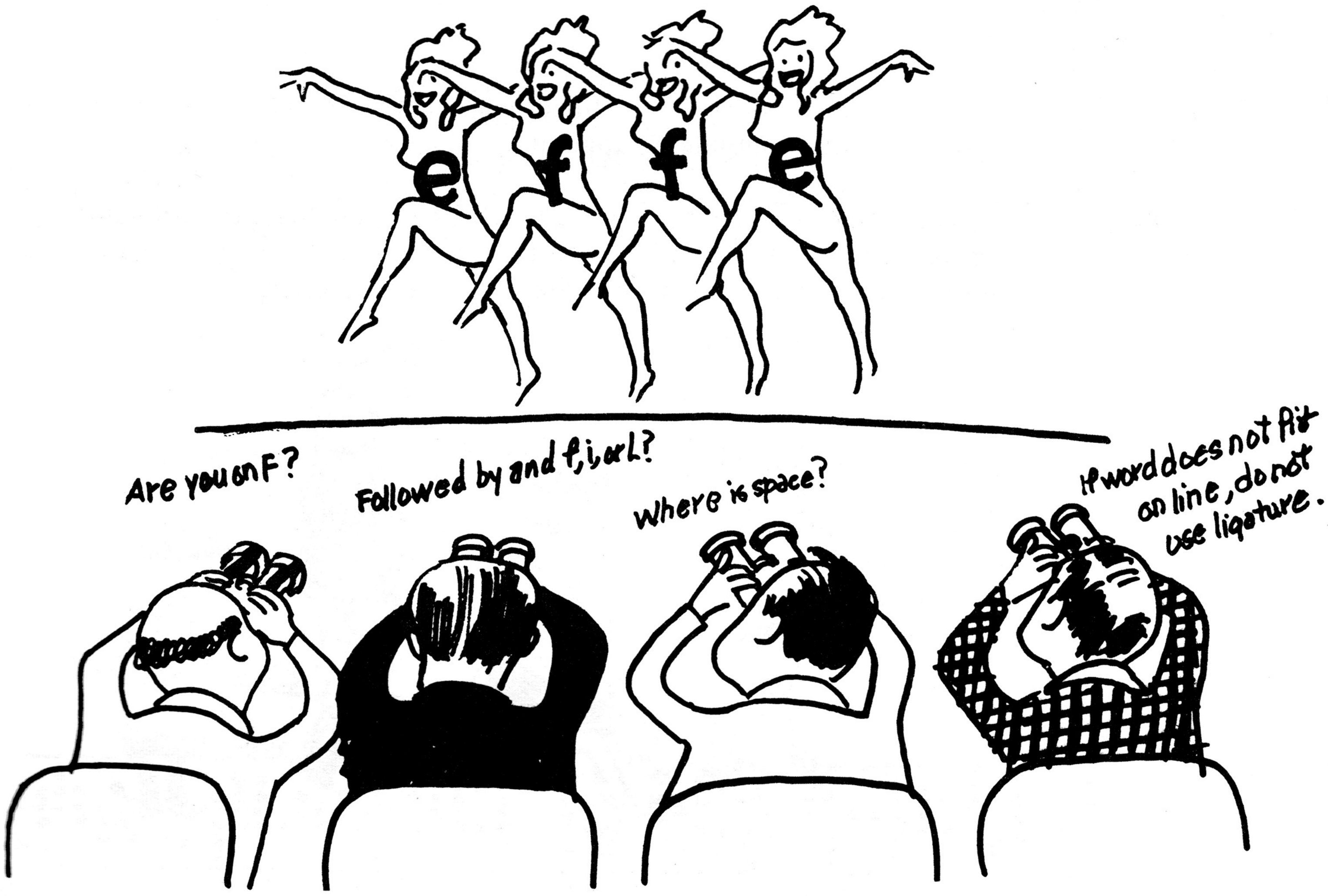


As characters are keyed (input directly or input via tape) they enter the computer's or typesetter's logic under the same kind of scrutiny that dance hall girls come on stage. The width value of every character is deducted from a counter on which the total line measure has been recorded.

Characters are, of course, read at speeds of a few to a few hundred a second. The typesetter continues to deduct width values and also counts the occurrence of word spaces.



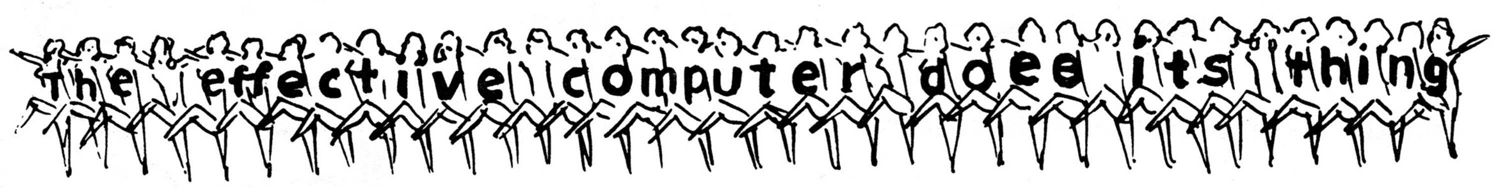
Certain letter combinations may be examined in the more sophisticated computer system, such as an "ff" combination. Here the computer may be programmed to replace this letter set with a ligature for more aesthetic typography. Also, this combination is noted in case a line ending must be made. Characters continue to be deducted.



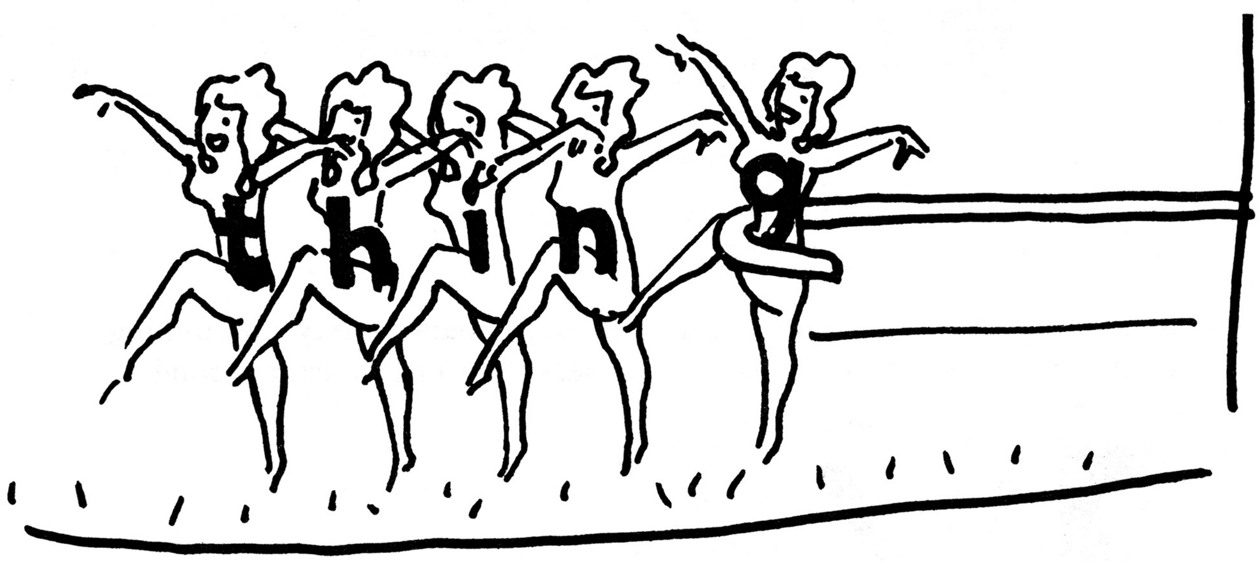
By now the end of the line is approaching. Width deduction is approaching the "justification" zone. This zone is determined by a calculation that counts the number of word spaces and establishes minimum and maximum expansion values. If a word space cannot expand, the line is too tight; if it can expand too far, the line is too loose.

All characters that may possibly fit on a line are "in". However, if the line is too tight, a letter or several letters must be removed. There are three alternatives: drop the word to the next line, or hyphenate it and drop certain characters to the next line, or force justify the line.

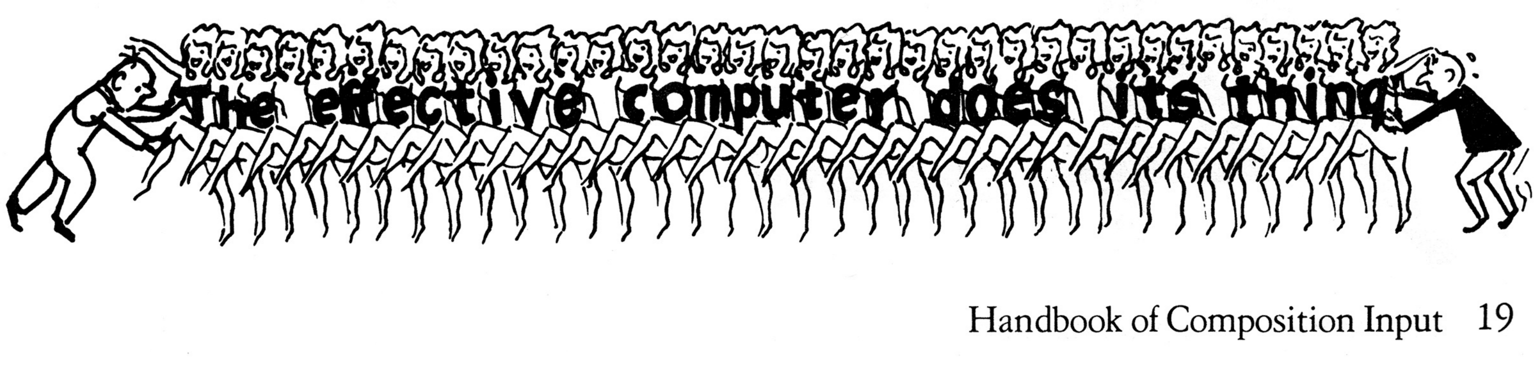
First, hyphenation is tried. There are two basic ways: by rules of logic, grammatical constants that will work in a majority of cases, or dictionary, a look-up system where words are compared to a separate word list with acceptable break points indicated.



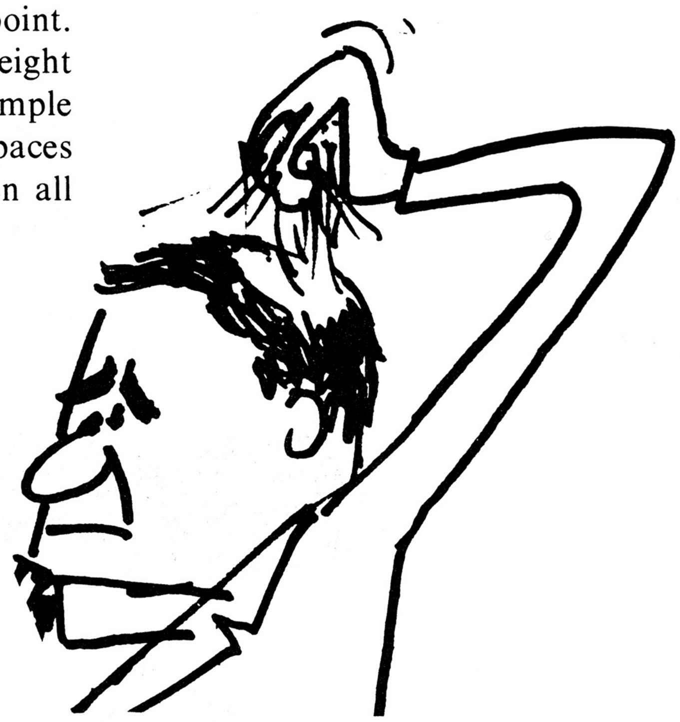
One character at a time is dropped until a good hyphenation point is reached.



If it isn't, the machine will attempt to keep all characters on the line with word spaces shrunk to their absolute minimum width.

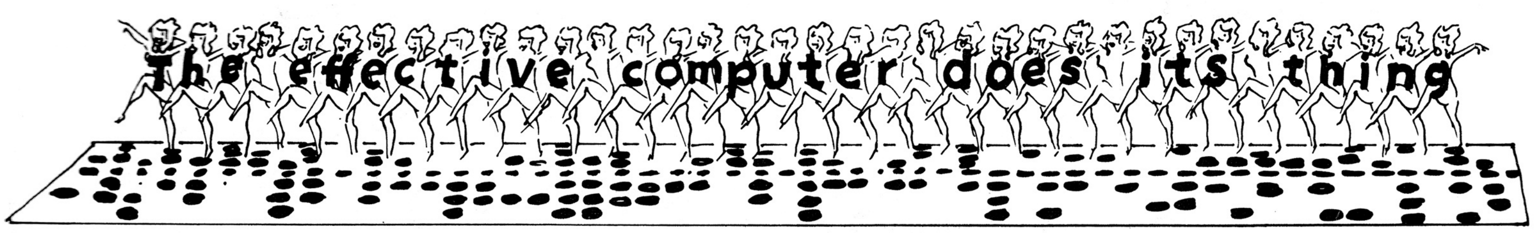


We have now input all our characters and determined our line ending point. If our measure was set at 30 picas and all characters total 22 picas, the eight pica difference is divided into the number of word spaces. In this example there are eight word spaces, so each space is one pica. If the word spaces were too wide, thin or hair spaces would be inserted equally between all characters. This is called letterspacing.



Measure	**30 picas**
Total character width	**—22 picas**
Total interword space	**8 picas**
Number of spaces	**8**
divide	**1 pica per interword space**

The final line is now photographed, the same total width (measure) as every other line. All left and right margins line up. This is justification, one of the most important functions performed in typesetting.



And by the way, the entire sequence described, although it may vary among typesetters or computers, takes something less than one quarter second to occur.

1/4 second

How to drive a typesetter

The preceeding information has laid the groundwork for an understanding of what a typesetter does. To review

A typesetter:

a. Produces various typographic characters
b. Produces various sizes of characters
c. Produces various styles of characters
d. Produces various line lengths of characters
e. Produces various placements of characters (e.g.: quadding, leading)

Thus an input device must provide the methodology to access the specific characters and capabilities of which the typesetter is capable. The illustration on this page is a list of all the *flashable* characters in one font of a 102-character phototypesetting font. Thus the input device must have sufficient keytop designations to allow the operator to locate and set these characters. The input device must also have the ability to access all or some of the following typesetter *commands:*

1. Quad Right
2. Quad Left
3. Quad Center
4. Insert Space
5. Insert Leader
6. Insert Rule
7. Tab Set
8. Tab
9. Back or Foward One Unit
10. Back or Foward One Point
11. One-half Point Line Space
12. One Point Line Space
13. Line Measure Set
14. Line Space Set
15. Point Size Set
16. Type Style Set
17. Space Only
18. Flash Only
19. Carriage Reset
20. End Line
21. Super Shift
22. Discretionary Hyphen
23. Cancel Word
24. Cancel Line
25. Cancel Character

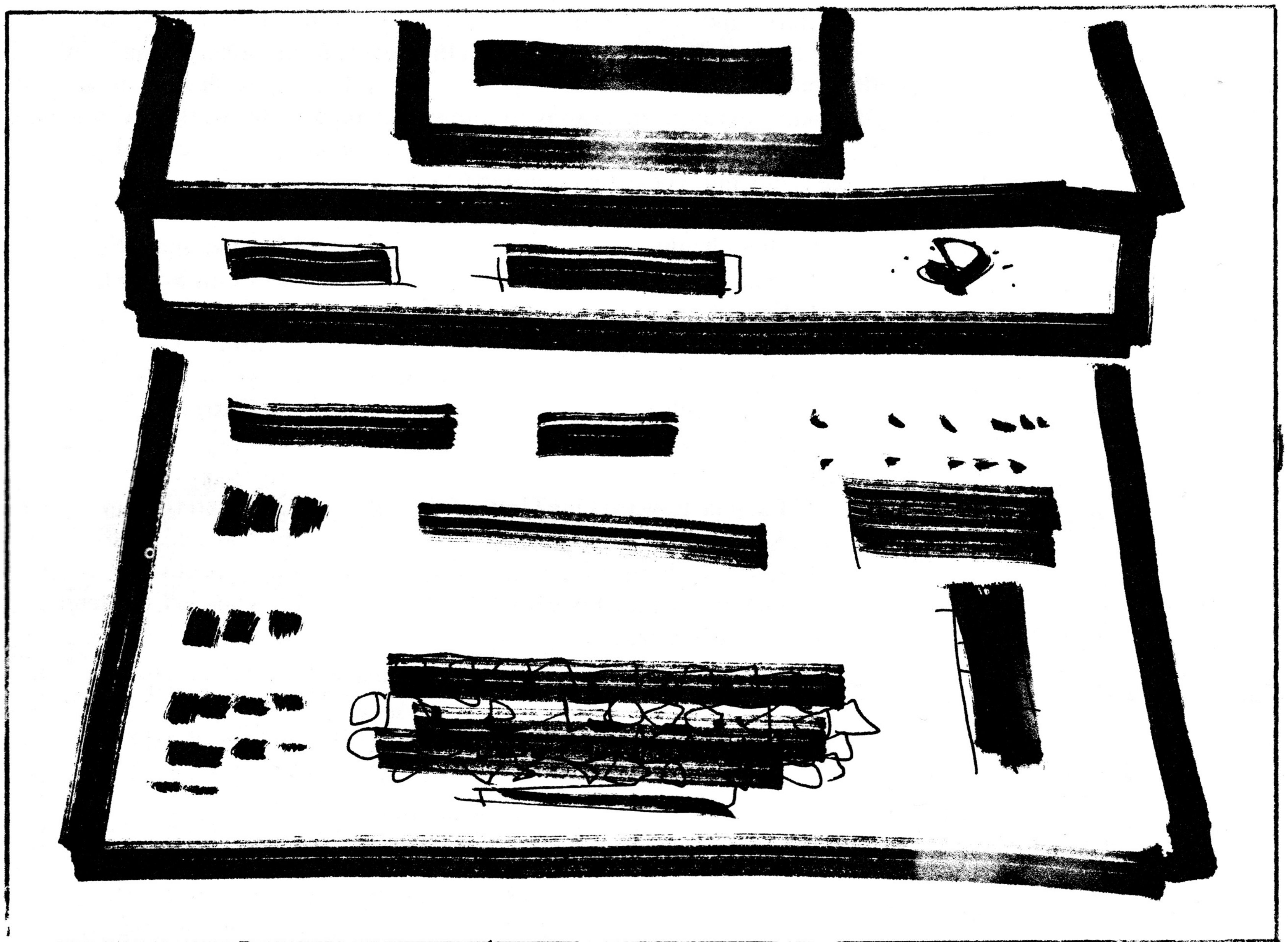
						CASE (Shift)		CHAR-ACTER
[illegible] Configuration	5	4	3	2	1		0	
[illegible] Configuration	0	1	2	3	4	5	6	7
[illegible]
[illegible]	0	0	0	1	1	0	0	1
[illegible]	0	0	0	1	1	1	0	1
[illegible]	1	1	0	0	1	0	0	1
[illegible]	1	1	0	0	1	1	0	1
[illegible]	0	1	1	1	0	0	0	1
C	0	1	1	1	0	1	0	1
[illegible]	0	1	0	0	1	0	0	1
D	0	1	0	0	1	1	0	1
[illegible]	0	0	0	0	1	0	0	1
E	0	0	0	0	1	1	0	1
[illegible]	0	1	1	0	1	0	0	1
F	0	1	1	0	1	1	0	1
[illegible]	1	1	0	1	0	0	0	1
G	1	1	0	1	0	1	0	1
[illegible]	1	0	1	0	0	0	0	1
[illegible]	1	0	1	0	0	1	0	1
[illegible]	0	0	1	1	0	0	0	1
[illegible]	0	0	1	1	0	1	0	1
[illegible]	0	1	0	1	1	0	0	1
[illegible]	0	1	0	1	1	1	0	1
[illegible]	0	1	1	1	1	0	0	1
[illegible]	0	1	1	1	1	1	0	1
[illegible]	1	0	0	1	0	0	0	1
L	1	0	0	1	0	1	0	1
[illegible]	1	1	1	0	0	0	0	1
[illegible]	1	1	1	0	0	1	0	1
[illegible]	0	1	1	0	0	0	0	1
[illegible]	0	1	1	0	0	1	0	1
[illegible]	1	1	0	0	0	0	0	1
O	1	1	0	0	0	1	0	1
[illegible]	1	0	1	1	0	0	0	1
P	1	0	1	1	0	1	0	1
[illegible]	1	0	1	1	1	0	0	1
[illegible]	1	0	1	1	1	1	0	1

						CASE (Shift)		CHAR-ACTER
TTS Bit Configuration	5	4	3	2	1		0	
ACM Code Configuration	0	1	2	3	4	5	6	7
CHARACTER								
r	0	1	0	1	0	0	0	1
R	0	1	0	1	0	1	0	1
s	0	0	1	0	1	0	0	1
S	0	0	1	0	1	1	0	1
t	1	0	0	0	0	0	0	1
T	1	0	0	0	0	1	0	1
u	0	0	1	1	1	0	0	1
U	0	0	1	1	1	1	0	1
v	1	1	1	1	0	0	0	1
V	1	1	1	1	0	1	0	1
w	1	0	0	1	1	0	0	1
W	1	0	0	1	1	1	0	1
x	1	1	1	0	1	0	0	1
X	1	1	1	0	1	1	0	1
y	1	0	1	0	1	0	0	1
Y	1	0	1	0	1	1	0	1
z	1	0	0	0	1	0	0	1
Z	1	0	0	0	1	1	0	1
Base Line Rule (BLR)	0	0	0	1	0	0	0	1
Star	0	0	0	1	0	1	0	1
Asterisk	0	1	0	0	0	0	0	1
Check	0	1	0	0	0	1	0	1
FRACTIONS								
Three-Quarters	0	1	0	1	1	0	1	1
One-Quarter	0	1	0	1	1	1	1	1
One-Half	0	0	1	0	0	0	1	1
One-third	0	0	1	0	0	1	1	1
NUMERICS								
1	1	1	1	0	1	0	1	1
Superior 1	1	1	1	0	1	1	1	1
2	1	0	0	1	1	0	1	1
Superior 2	1	0	0	1	1	1	1	1
3	0	0	0	0	1	0	1	1
Superior 3	0	0	0	0	1	1	1	1
4	0	1	0	1	0	0	1	1
Superior 4	0	1	0	1	0	1	1	1

						CASE (Shift)		CHAR-ACTER
TTS Bit Configuration	5	4	3	2	1		0	
ACM Code Configuration	0	1	2	3	4	5	6	7
CHARACTER								
5	1	0	0	0	0	0	1	1
Superior 5	1	0	0	0	0	1	1	1
6	1	0	1	0	1	0	1	1
Superior 6	1	0	1	0	1	1	1	1
7	0	0	1	1	1	0	1	1
Superior 7	0	0	1	1	1	1	1	1
8	0	0	1	1	0	0	1	1
Superior 8	0	0	1	1	0	1	1	1
9	1	1	0	0	0	0	1	1
Superior 9	1	1	0	0	0	1	1	1
0	1	0	1	1	0	0	1	1
Superior 0	1	0	1	1	0	1	1	1
PUNCTUATION								
Semi Colon	1	1	0	1	0	0	1	1
Colon	1	1	0	1	0	1	1	1
Close Paren	1	0	0	0	1	0	1	1
Open Paren	1	0	0	0	1	1	1	1
En Bullet	1	1	1	1	1	0	1	1
Register Mark	1	1	1	1	1	1	1	1
Hyphen	0	1	0	0	1	0	1	1
Dash	0	1	0	0	1	1	1	1
Percent	1	0	1	1	1	0	1	1
Superior $	1	0	1	1	1	1	1	1
Slash	1	0	0	1	0	0	1	1
Superior Cent	1	0	0	1	0	1	1	1
Query	1	0	1	0	0	0	1	1
Ampersand	1	0	1	0	0	1	1	1
Comma	0	1	1	0	0	0	1	1
Comma	0	1	1	0	0	1	1	1
Period	1	1	1	0	0	0	1	1
Superior Period	1	1	1	0	0	1	1	1
Close Quote	0	1	0	0	0	0	1	1
Open Quote	0	1	0	0	0	1	1	1
Dollar ($)	0	0	0	1	1	0	1	1
Exclamation	0	0	0	1	1	1	1	1

Characters that can actually be photographed include these above (ACM 9000).

These tell the typesetter where and how to put the characters on the output medium. It is probably evident by now that an input keyboard, attempting to access all characters and functions via single or double keystrokes, would require a bewildering array of keys. Here is a photo and layout of Compugraphic's ACM 9000 Keyboard. Note how it attempts to deal with single keystroke command of type style and size, two ever-changing areas of display composition. Single strokes here mean faster keyboarding. However, to access type style and size changes for the ACM 9000 via a standard 6-level keyboard requires a minimum of three keystrokes. To call in type style on Row 1, the operator keys: SUPERSHIFT, "F" (for face), "1" (for Row 1). Let us review why multiple keystrokes are needed.



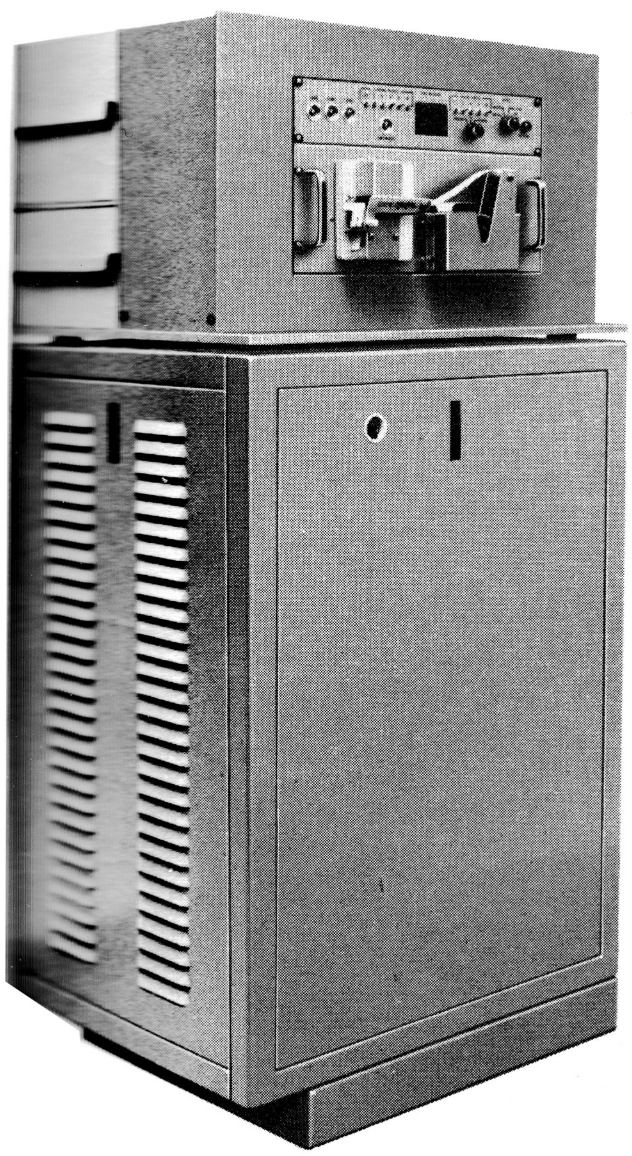
The ACM 9000 direct entry keyboard.

The standard typewriter keyboard layout has 44 character keys (including SPACE); each key usually controlling two characters, which are selected via the SHIFT key. There are 26 alphabetic keys (for capitals and lower case letters), 10 numerical keys (for figures and special characters), 5 punctuation keys (but only 8 unique characters out of 10 possible positions, since the period and comma are repeated in the SHIFT position), and 2 extra keys for fractions and rule line. 84 unique characters from 88 character positions. The SHIFT and RETURN keys are *function* keys since they control the way the machine operates.

The teletype has only 32 keys to access 64 character or function positions. There are only capital characters.

The Linotype Keyboard layout has a total of 90 keys (plus the ELEVATE) to access the 90 channels of the magazine. Character matrices in each channel contain a duplexed pair of characters; that is, there are two separate positions, called UPPER RAIL and LOWER RAIL, both of which are the same width value. Thus the linotype has 90 keys to access 180 characters. This represents two complete alphabets in one type size and style, duplexing a typeface with its companion italic or boldface version. Note that the layout is arranged with the more frequently used characters more prominently positioned. Shown is keyboard Diagram 12.

Along came the TTS Standard Perforator. It combined the standard typewriter layout with the function controls necessary to run the linotype. Compare the character set from both layouts. Missing are the small caps, since they were not used for newspaper work. The Linotype keyboard Number 282 the newspaper version (282 f included fractions). Unlike the typewriter, the TTS keyboard clearly differentiated between SHIFT and UNSHIFT. These were unique codes. The RUB OUT was a correction key: the tape was backed up to the incorrect code and when struck, RUB OUT inserted holes in all channels. UR and LR accessed the Upper Rail and Lower Rail position of the matrix. The BELL key signaled the receiving end of a TTS transmission that a tape was coming in. Other versions of the TTS keyboard were available to set non-unit cut typefaces, and to mix other faces and sizes by commanding UM and LM (Upper Magazine and Lower Magazine) changes. Keytops were also changed to represent characters running in the Linotype channels that deviated from standard layouts.



As phototypesetting came more into use the number of characters per font increased. Sizes were changed by positioning lenses instead of entirely new fonts. More typefaces were available at one time. And electronically-controlled photographic typesetting provided more capability and thus more commands were necessary to access them. Intent on utilizing existing keyboards to drive some of the new typesetters, users were forced to strike more than one key to change a size or face or even flash one of the extra characters over the normal keyboard set.

Subsequent keyboards increased the character and command set on the keyboard and, in some cases, provided multi-code keys. These keys perforated two or three codes in sequence with one keystroke. Two trends have gone foward simultaneously since then: 1. to adapt phototypesetters to run from the existing reservoir of keyboards, and 2. to design keyboards specifically to run phototypesetters. The result has not been one of logical order and method.

This is Compugraphic's 2961. It was the first phototypesetter ever priced under $10,000. For the price a user received a two-font typesetter that could accept justified and unjustified six level tape. A hard wired computer, based somewhat on CG's Justape, provided hyphenation and justification.

Phototypesetting is in its third generation. First generation devices utilized operating principles from hot metal linecasting machines but used photography in place of actual metal casting.

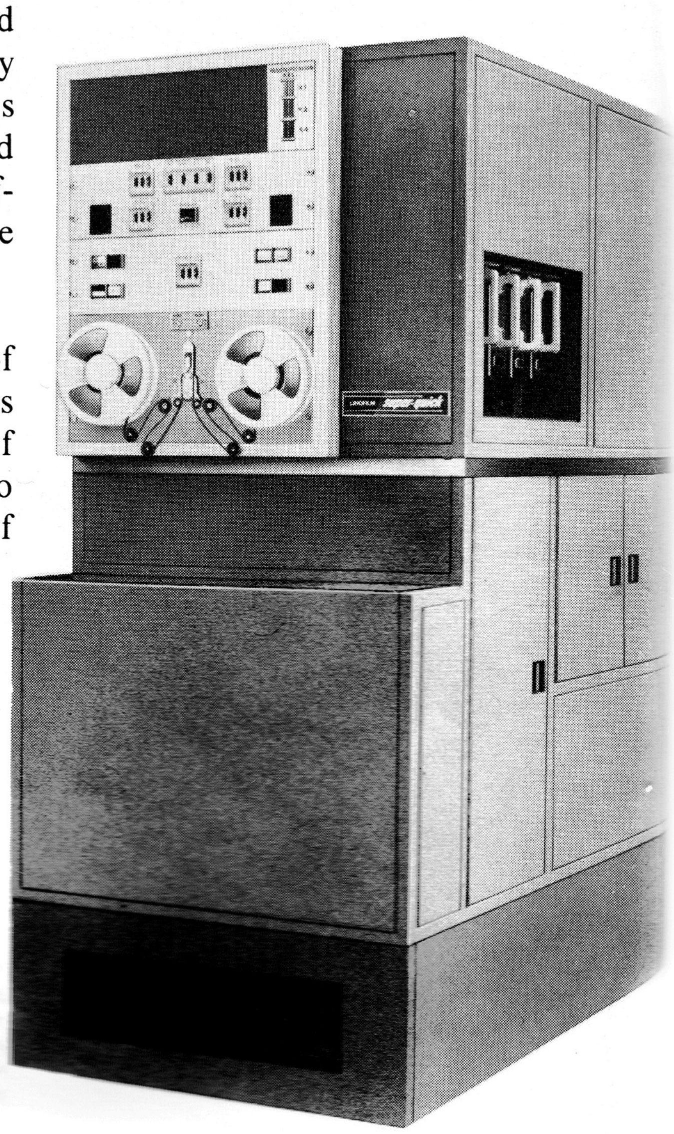
Second generation phototypesetters use photomechanical methods to select and expose character images on photographic material. These machines were developed in the 1950's and have undergone continual refinement ever since. Third generation devices are fully electronic machines ~~based~~ on cathode ray tube (CRT) technology. They were developed around 1965 and are still undergoing significant changes.

Second generation photopypesetters produce typeset copy from master characters stored photographically within the machine. The major subsystems used to produce the copy include input, character selection, image output control, and interline separation. Although the basic principles used by all manufacturers are similar, numerous variations in design complexity and configuration present a vast array of alternative methods for setting copy.

Phototypesetters use codes from an input source to activate machine responses that produce typeset copy. The codes identify parameters that control the operation including: (1) characters to be typeset, (2) desired fonts and point sizes, (3) interword spacing for line justification, and (4) desired interline spacing.

Input sources for second generation devices are: (1) direct keyboard entry, (2) keyboard-controlled perforated paper tape, and (3) computer-controlled paper or magnetic tape. Early systems used entry by keyboards directly interfaced with the machine and were designed for use by skilled operators who understood the function codes required to typeset copy and who could divide the copy into justified lines. This method was slow because of end-of-line justification decisions and extra coding strokes had to be made manually, (Photon 200 series).

As faster, and more flexible phototypesetters became available, the use of keyboard perforating units for paper tape became more popular. These units changed keyboard text entry into an off-line operation and made the use of multiple keyboards for a single phototypesetter possible. This method also allowed the typesetter to operate at its maximum speed rather than that of the keyboard operator.



Linofilm Quick was supposed to be a low cost phototypesetter when it made its debut in 1964. It was priced around twenty thousand dollars and competed successfully with the sixty grand units then dominating the marketplace. The Quick could only accept justified six level tape. An optional reader was available to accept Justowriter tapes but as far as is known only one was ever sold.

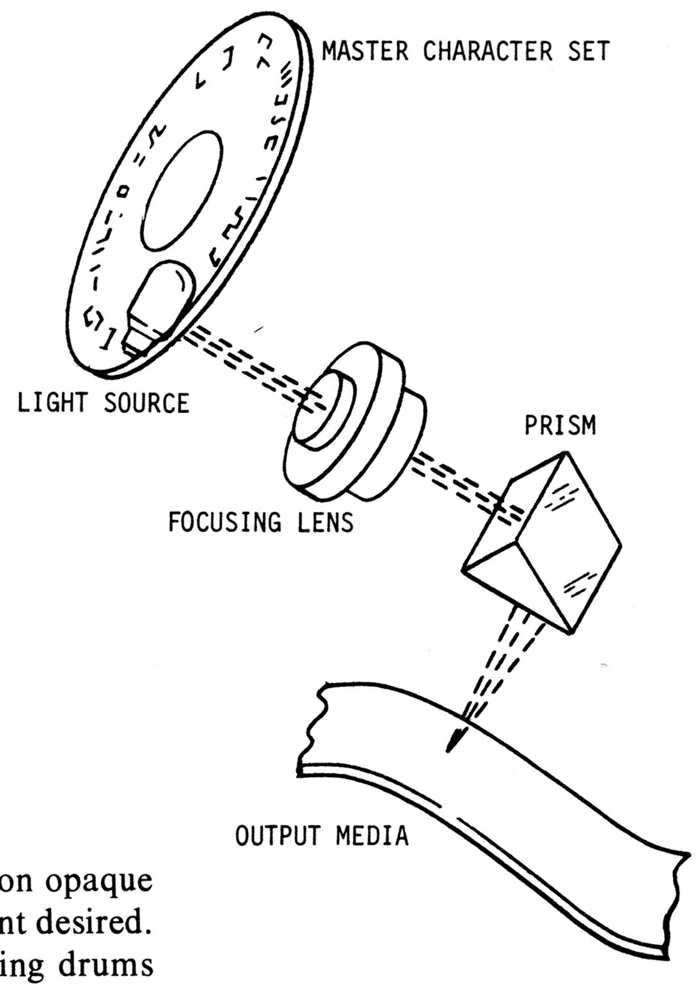
Photon's 713 series of phototypesetters incorporated the necessary logic to produce hyphenless justification. With switches on the control unit, function commands could be over-ridden in order to reset copy without rekeyboarding.

Perforated paper input tapes may also be generated by general purpose computers. These computers normally provide the flexibility and speed to perform composition work on a variety of large, complex typesetting jobs as well as other business applications. General purpose computers are capable of taking information from computer-generated data banks, such as telephone directories or parts catalogs, and, under the guidance of an appropriate program, prepare it for phototypesetting without the step of keyboard entry. Elimination of this step greatly enhances the efficiency and accuracy of the total system, as keyboard entry has historically been a bottleneck in the photocomposition process.

An additional input source available with some phototypesetters is computer-generated magnetic tape. Magnetic tape carries the same coded input data as paper tape and permits much higher entry speeds with improved handling characteristics.

Character selection consists of a light source, master character set, and control logic to synchronize the light source and character set. The light source is of high intensity and may be continuous or may operate stroboscopically with a flash duration of one or two microseconds (millionths of a second). The light source normally used is a xenon flash lamp or flash tube. For larger point sizes the lamp is flashed twice (multi-flash) to assure that the film is fully exposed for uniform character blackness (density).

A basic phototypesetting system: light source, lens, prism or mirror and photosensitive material.

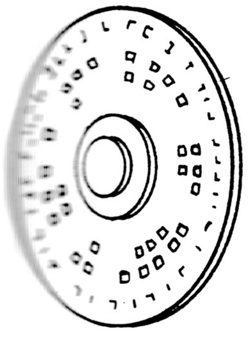


Master character sets are transparent negatives (clear characters on opaque backgrounds) which supply character images in the typeface or font desired. Master character sets are stored on: (1) rotating discs, (2) rotating drums with interchangeable film strips, (3) rotating turrets, or (4) stationary grids. In all cases, master character sets are interchangeable to permit insertion of desired fonts not already in the machine. Some phototypesetters offer multiple character arrays with up to five discs or four grids.

The process of character selection begins by coded information from the input source being read into the machine's control logic. As the logic unit recognizes the character and font code, it determines where the desired font is located in relation to the light source. In machines with single character set arrays, all available fonts are located in front of the light source. Multiple character set arrays may find the desired font elsewhere and move it into position before the light source. Simultaneously, the logic unit is selecting the proper light source, when more than one is available, and positioning the apertures, mirrors, and lenses used to isolate the desired character.

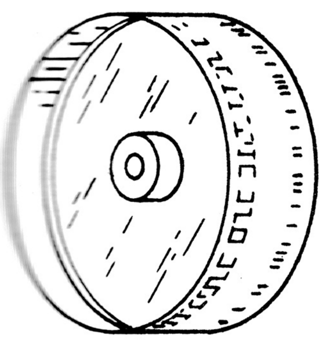
As the proper character image approaches the light source, most systems use a series of timing marks on the master character set or timing pulses to synchronize action between the light source and the character image. On some machines the timing mechanism will cause the character to be projected to stop in front of the light source. However, on most machines the extremely fast stroboscopic light source is sufficient to obtain high quality output by simply flashing at the exact moment the character image is in front of the light source. Once the proper character is selected and its image is optically initiated, image output control begins.

Image output controls and positions the character image on the output media. Components of the subsystem include an optical projection mechanism to focus, direct, and magnify the projected light rays and a spacing mechanism to accurately provide intercharacter and interword spacing.



DISC

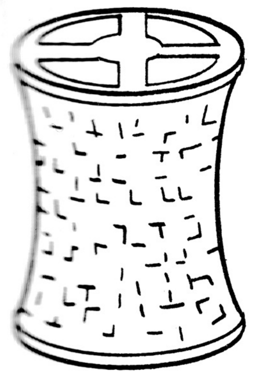
Optical projection mechanisms vary significantly among phototypesetters. Rotating character sets normally carry several fonts around the rotating surface. The stroboscopic light flash illuminates a complete row of characters rather than isolating individual characters. A series of apertures, mirrors, or lenses moves into a unique set of positions in response to function codes on the input tape. The desired character image is thus guided into the optical path while all others are deflected away. As the number of fonts on an individual rotating character set increases so does the complexity of the optical system required to isolate and project individual characters.



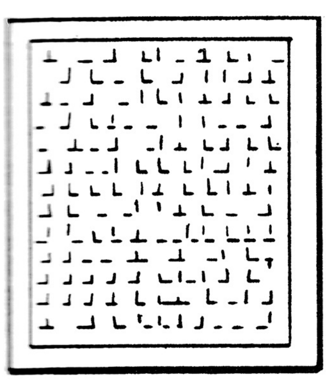
DRUM

Stationary grid systems are the most complicated systems of all for optical character isolation. Since character images on the grids are stationary and not rotating past the light source, a continuous light source is used. Light is distributed evenly over the grid by condenser lenses specifically designed for this purpose. The effect is illumination of an entire matrix of character images rather than a single row. The light rays from each character are formed into a beam of virtually parallel rays by a series of lenses called a collimator assembly. The rays then enter a series of eight pairs of optical wedges designed to isolate the desired character image. Directed by codes on the input tape, the wedges move to a unique set of positions for that character. The refractive angles on the wedges guide light rays from the appropriate character along the optical path and deflect all others away. A decollimator assembly is used to converge the parallel light rays and restructure the character on the output media (Linofilm Quick series).

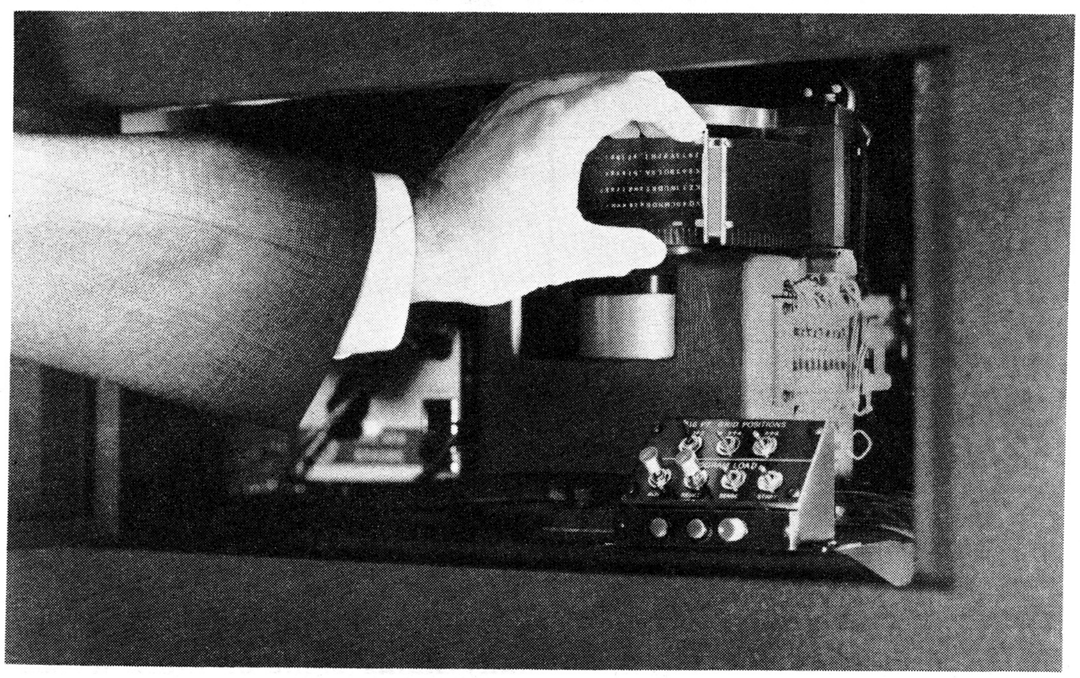
In typesetting, point size is a measure of type height. It measures the maximum height a font requires when adding together the maximum distance reached by characters extending both above and below the base line. A 72-point font requires one full inch to accommodate all characters within it. Normal text type ranges from 5 to 12 points and most newspaper and book headings are less than 18 points. Characters in point sizes over 18 points are normally considered as display characters.



TURRET



GRID



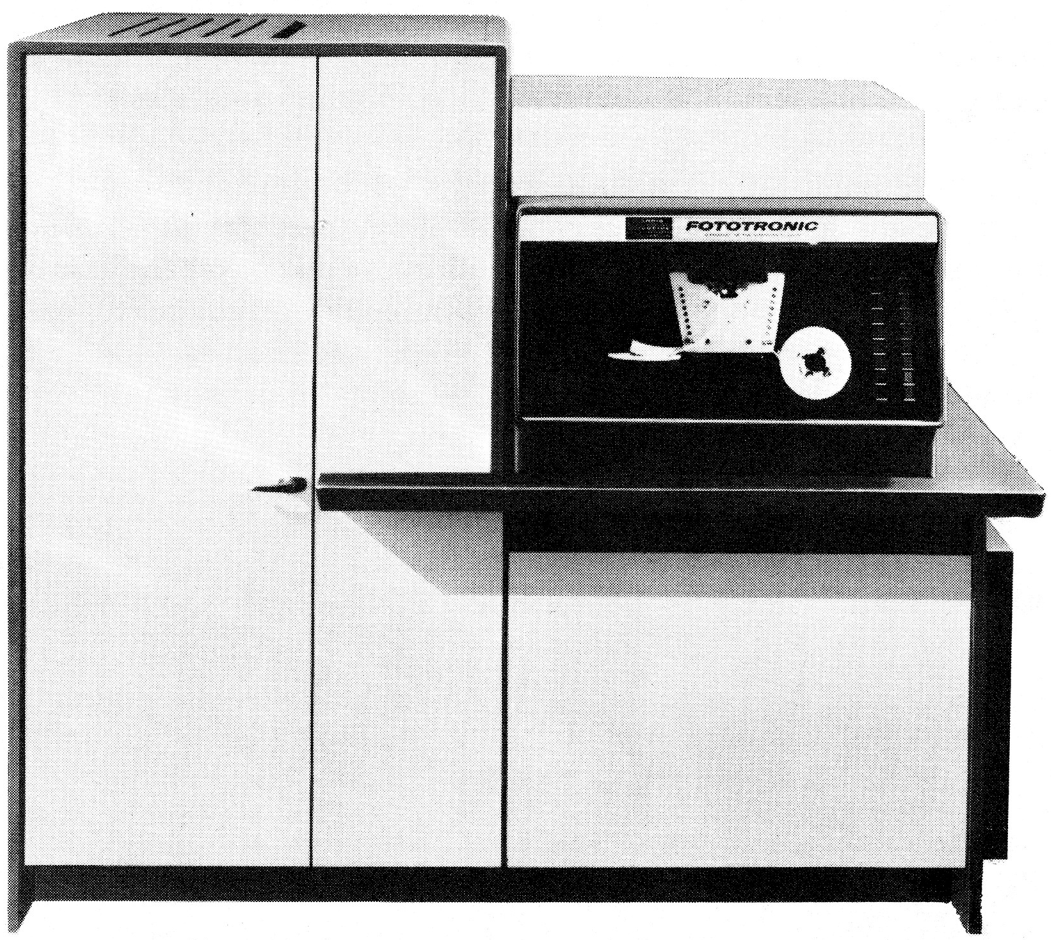
Photographic matrices come in varying formats: disc, drum, film strip, turret and grid.

Font grids installed on the Mergenthaler V-I-P.

All phototypesetters have available a range of character point sizes, called the point size range, but differ significantly in the number of specific settings available and the method for changing point size. Systems vary from manual insertion to highly automatic selection of numerous settings.

Systems that require manual changing of point size permit by far the most straightforward and inexpensive design of the image output control subsystem. In most of the low-priced text-oriented machines no mechanism to control point size is required, as manual changing of the master character set and the set-width gears is required. In several machines, manual adjustment of point size is accomplished by the setting of levers to correspond to the desired point size. Movement of the levers causes lenses in the main optical system to change position and vary magnification of the output.

In the Fototronic system, variations in magnification are accomplished automatically by movement of two lenses. Directed by function codes on the input tape, the movable lenses are driven along the optical axis by motors until positioned in the appropriate locations for the desired magnification.



The Harris-Intertype Fototronic. Input to this high quality phototypesetter is via special counting keyboard or computer.

The most commonly used method of obtaining different point sizes is a multi-lens turret. The turret normally holds eight or more lenses which provide a range of magnification levels. Each magnification level relates to a specific point size. The approprite lens is rotated into position in response to a coded command from the input tape. Lens turrets provide good typographic flexibility with reasonable photomechanical simplicity.

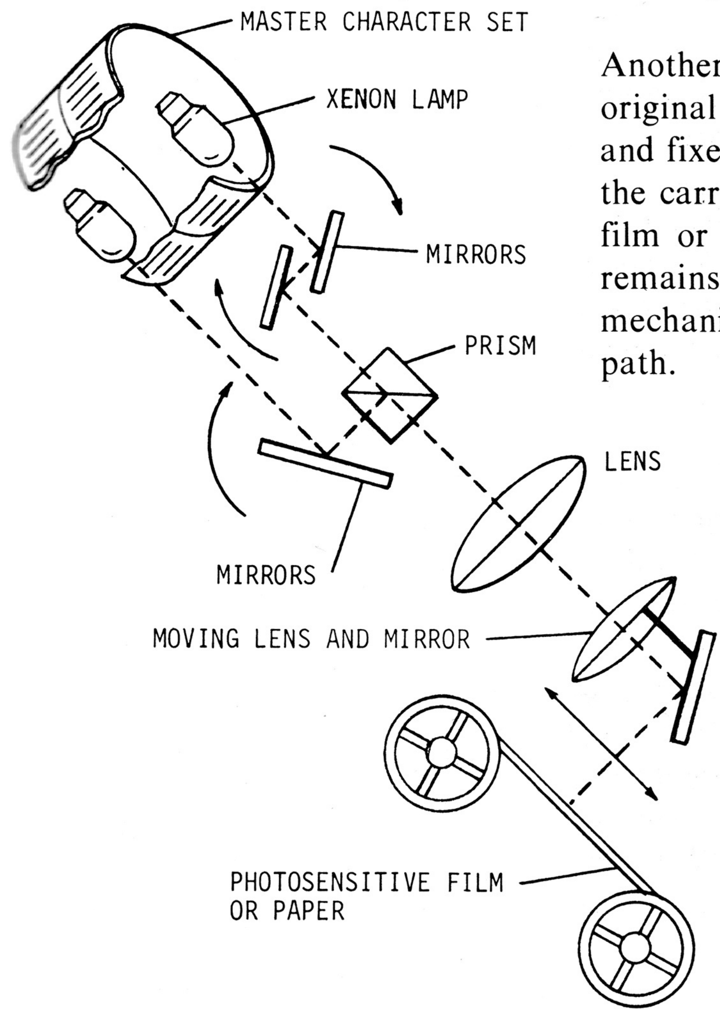
There are numerous methods by which proper intercharacter or interword spacing can be achieved. Two basic components are involved, the mechanism that physically sets and advances character images across the output media and the logic system which controls the amount of advance and synchronizes it with the stroboscopic light source.

A lens carriage which moves laterally across the output media to locate the character properly along the typeset line is the most inexpensive method available. After each character is set, the lens carriage advances a distance equal to the appropriate character width and is ready for the next character image. Master character widths are either permanently hardwired into the circuitry of the phototypesetter or are available through changeable width circuits called width plugs. The character widths are then applied to the carriage advance through a pair of set gears that must be changed for each change in point size.

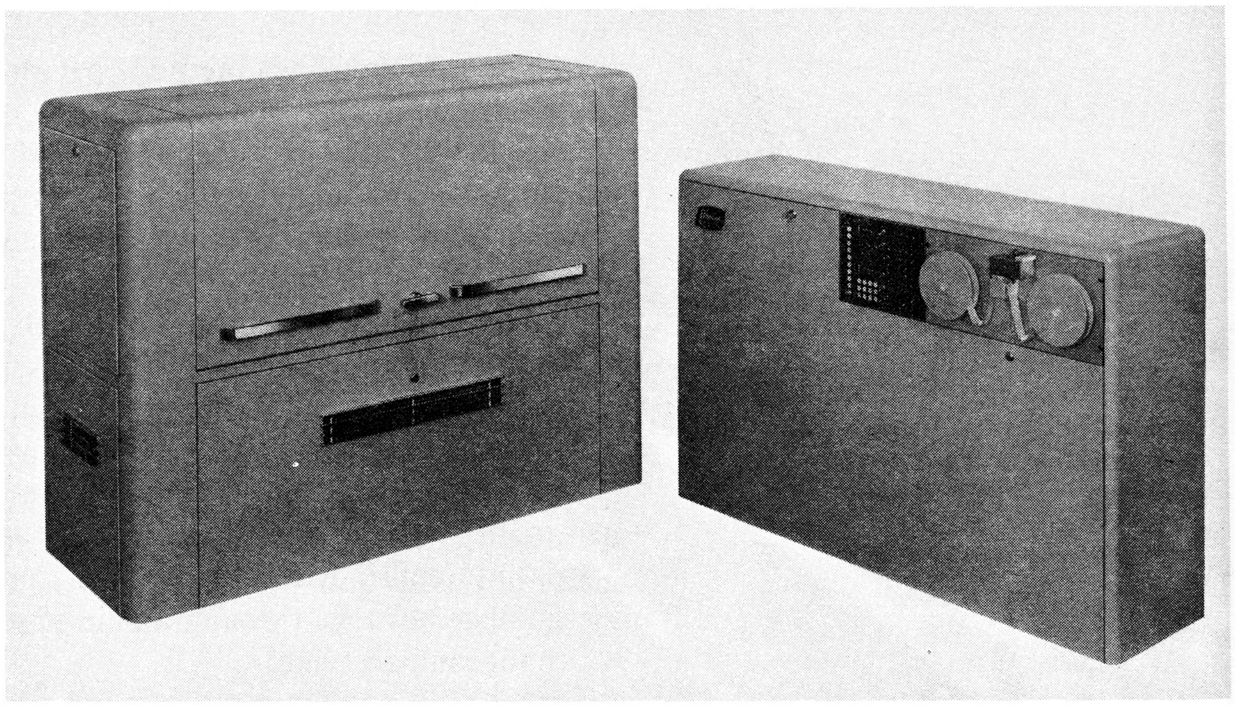
Another simple method for placing characters along the line is a positioning mirror that rotates to deflect the image the desired amount. Character focus is maintained by a focusing lens that moves in synchronization with the mirror. Rotation of the positioning mirror is controlled by a second optical system that generates electrical pulses to indicate the amount of rotation occurring. Rotation will stop when image deflection equals the appropriate character width. Perforated program tapes are used to load character widths into the machine memory in coded form. A new character width tape must be read into memory for each change in point size.

A third technique for correctly positioning characters along the line of copy involves a carriage that advances the light source and master character set literally in relation to the output media. The carriage advance is determined by the character width contained in the device's memory. Loading of the memory from special coded tapes before typesetting begins is again used.

Another method for proper character placement is a complex version of the original traveling lens carriage. In this system a carriage containing a lens and fixed mirror travels laterally in relation to the output media. However, the carriage is advanced only after several characters have been set on the film or paper. The task of proper character placement while the carriage remains stationary falls jointly to the character selection subsystem and the mechanism which isolates the desired character image along the optical path.



The Photon 713 imaging system.



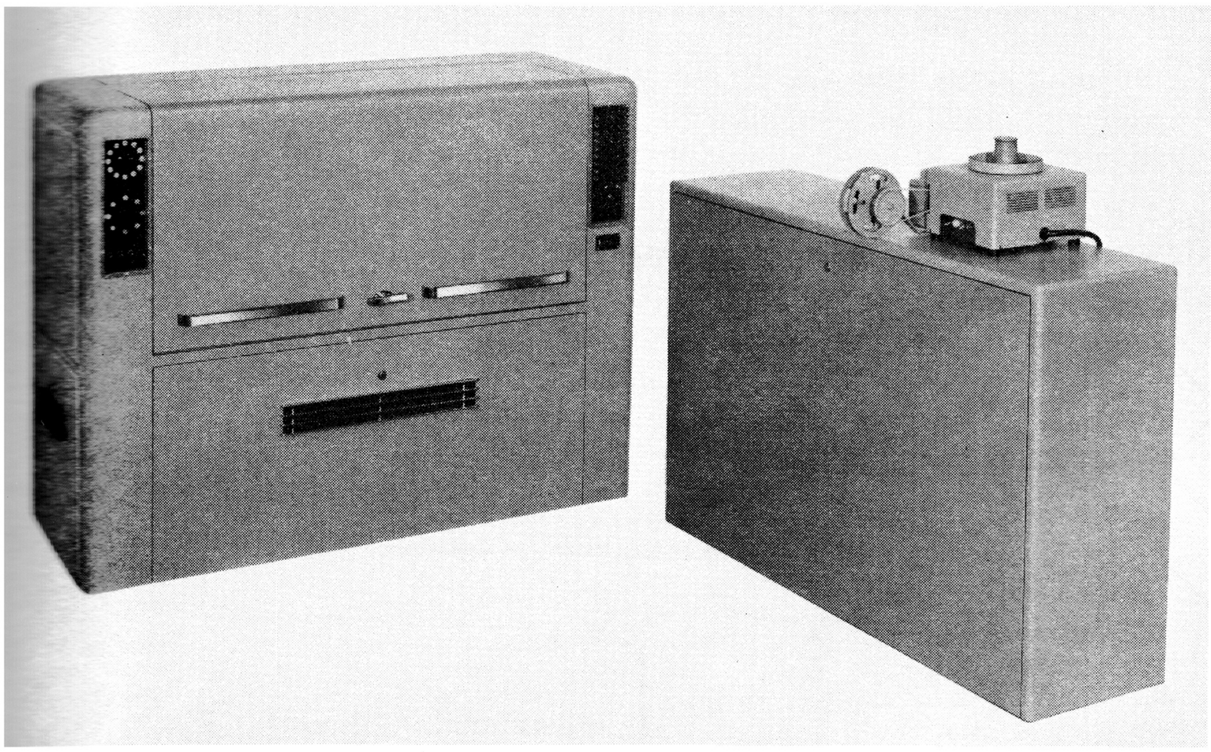
After the 200B, what...tape of course. Photon brought out additional units that only ran from tape. The 513 and 560, shown, were part of a series of units. The 560 was the first computer slave.

Immediately adjacent to the master character set are two movable apertures, one with two horizontal slits and one with a single vertical slit. Light passes through these apertures only at the intersection of the slits. Directed by the machine's control logic, the apertures are positioned so that light rays from only the desired character image pass through the intersection. However, due to control circuitry built into the machine, the projection of a specific character's image need not originate in precisely the same location each time the character is used. Timing of the flash and movement of the apertures can be controlled to vary the optical path between the displacement limits. Character width, interword spacing, and intercharacter spacing are all considered during movement of the optical path. Only after maximum displacement of the optical path has occurred will the carriage advance.

Interline separation or leading is simply the distance separating sequential lines of typeset copy. After each line is set, the end-of-line function code from the input source triggers a mechanism that advances the film or paper the proper distance. Leading information is often entered through a manual setting on inexpensive phototypesetters but is generally entered as a function code on larger, more versatile machines.

Third generation CRT phototypesetters produce typeset copy by means of electronic selection and exposure of character images on the face of a CRT. The major subsystems comprising a CRT phototypesetter include date input, character storage, character generation, and output pagination.

CRT phototypesetters usually operate in an off-line mode, with computer-generated magnetic tape as their input source. The tape contains the same character, function, and interline spacing codes associated with second generation devices. Magnetic tape is also used for font loading with those CRT phototypesetters using digital character storage.



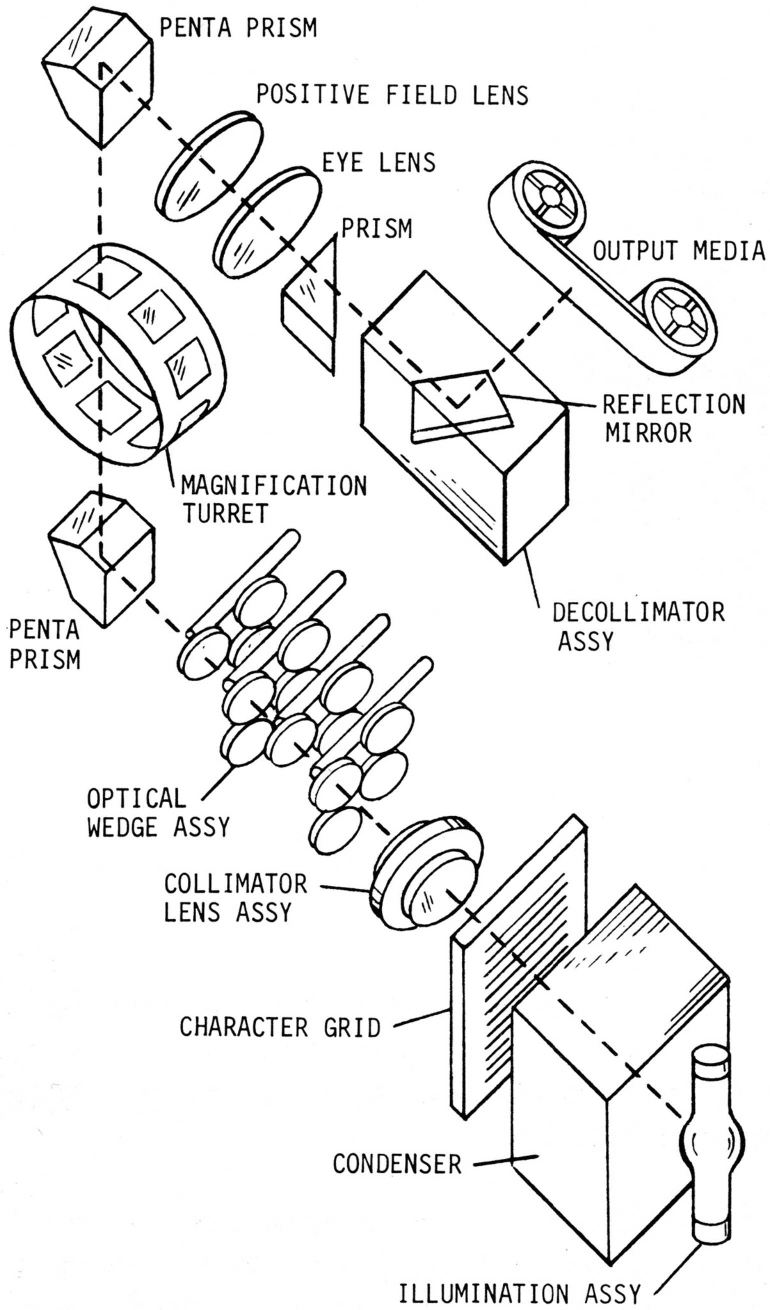
The Linotron 505 has an optional capability for magnetic tape input, but is primarily designed to operate from perforated paper tape input. In many ways, the Linotron 505 is more closely related to second generation phototypesetters than to other CRT devices.

Character storage in third generation phototypesetters is either photographic or digital. Photographic storage requires the positioning of master character sets in the optical path. Access to fonts not already stored within the machine requires manual changing.

Digital storage defines character shapes by digital coding read and processed by a computer. The information required to describe characters digitally is so large that peripheral magnetic disc systems are required to maintain a reasonable font selection within control of the computer typesetting system. Magnetic disc systems are currently used in two ways. (1) directly interfaced with the main computer system or (2) directly interfaced with the phototypesetter.

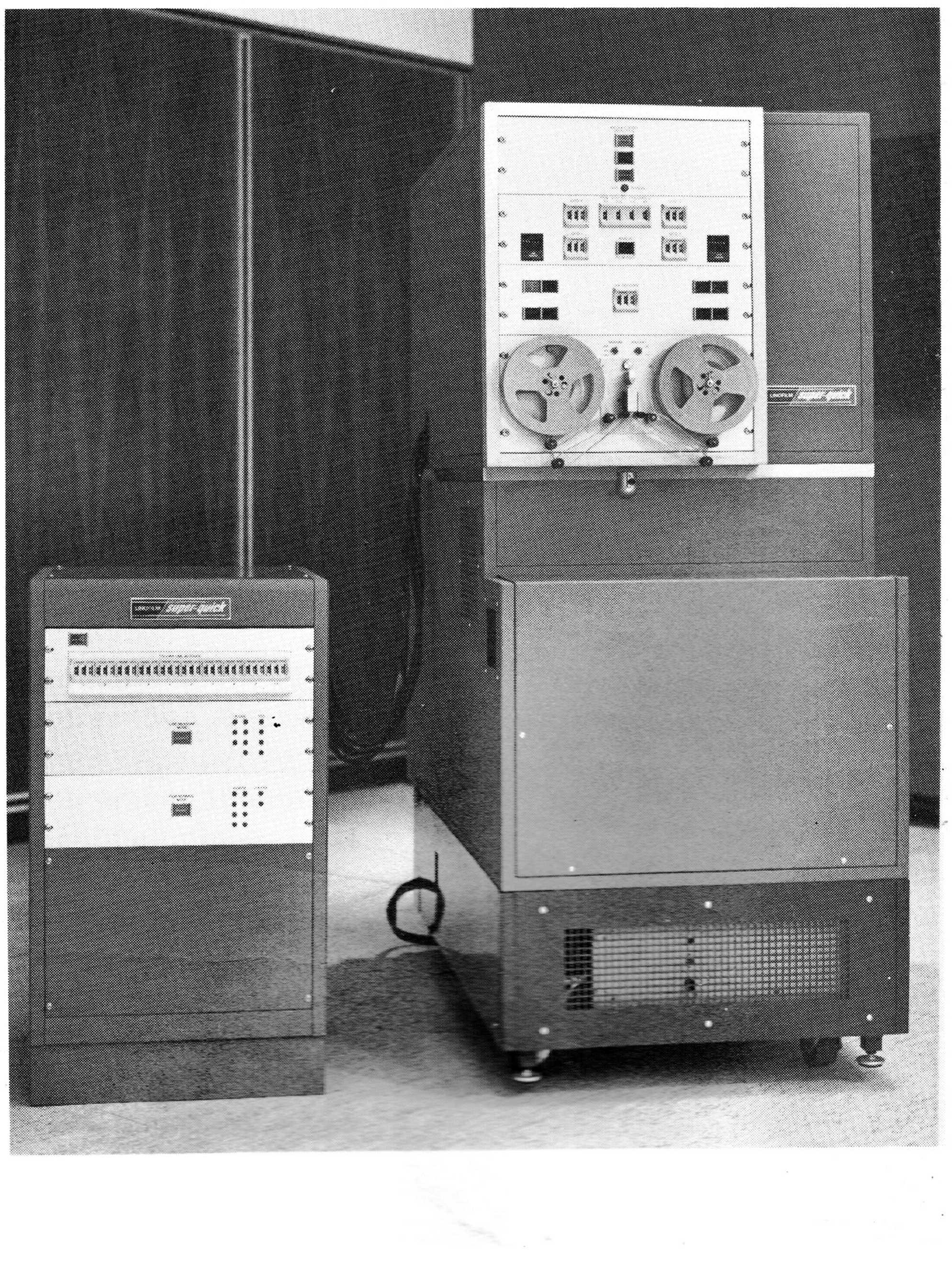
Magnetic disc systems peripheral to the computer enter digital font information into the phototypesetter by magnetic input tape. Upon entry, the information is stored in the magnetic core of a small control computer. Here the information is available ~~on-line as required.~~

Generation of character images for CRT phototypesetters occurs from electronic projection of character descriptions stored within the machine. Phototypesetters that use photgraphic storage employ two CRT's to generate character images. One CRT is a scanning device that describes the character and the second displays the character for exposure of the output media. Machines that store characters digitally use a single display CRT.

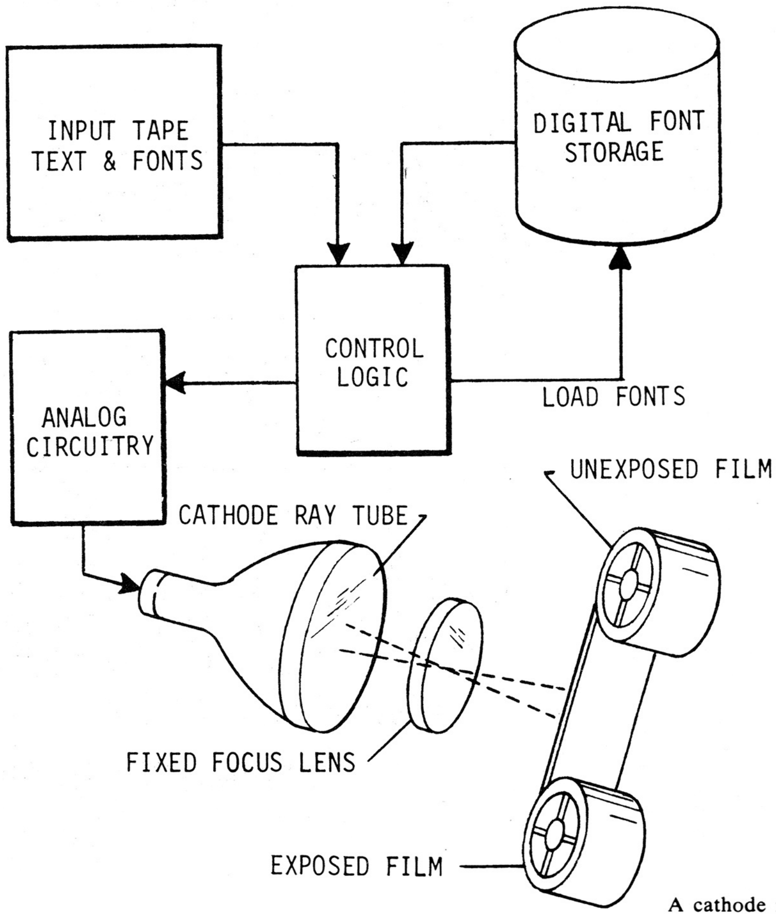


The Linofilm Quick imaging system uses a stationary matrix.

The Super Quick and Wide Range Super Quick were, and still are, expanded versions of the basic Quick photosetter. The unit on the left is the optional Tabmatic unit for tabular composition.



Also part of character generation for CRT phototypesetters is the system used to change point sizes. In scanning systems, height adjustments are made by changing the length of the stroke. Width changes are more complex and must be accomplished by either, (1) increasing the dimensions of the electron beam while spacing the strokes further apart, or (2) maintaining a constant electron beam size and using more strokes to describe the character.

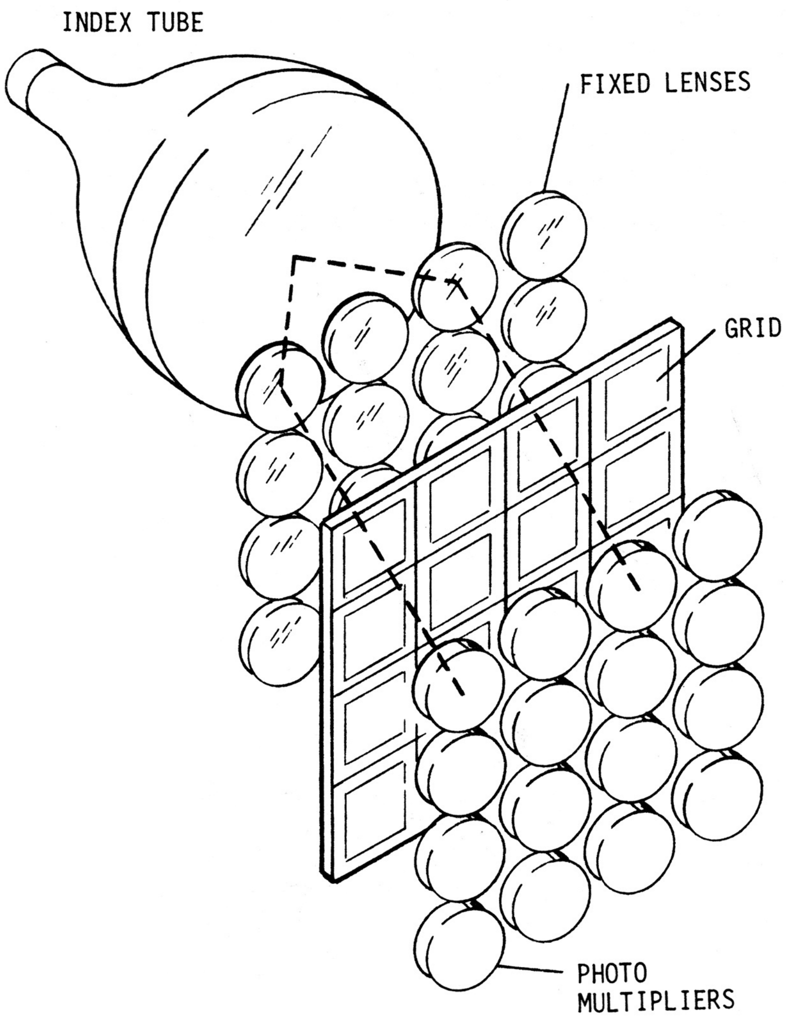


A cathode ray tube (CRT) typesetting system. There is no physical matrix. Characters are formed on the face of the tube from dot or stroke placement information maintained in the unit's logic.

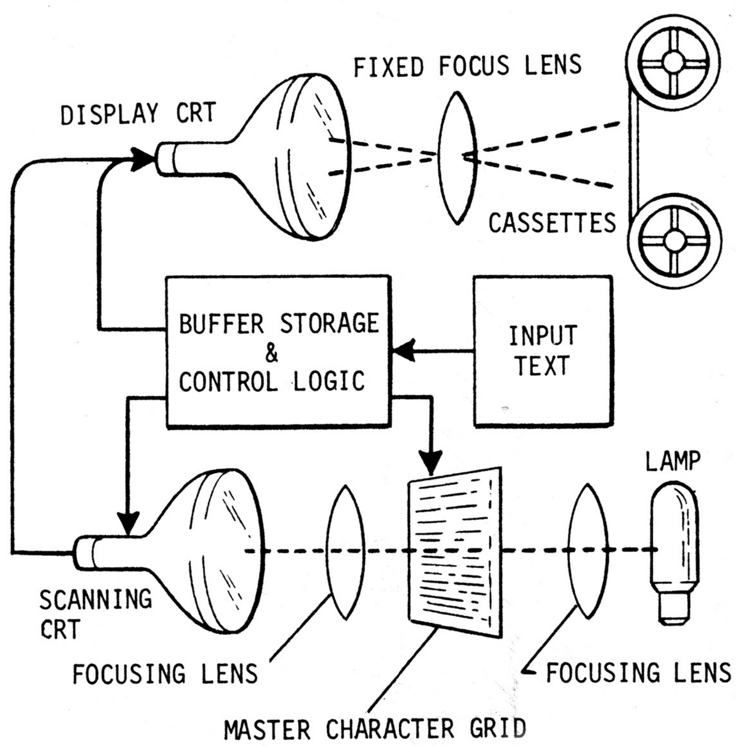
CRT phototypesetters designed for photographic character storage vary point size by using a constant stroke width in the display CRT and increasing or decreasing the number of strokes used to describe the character. This is done by varying spacing of the vertical scan lines in the scanning CRT in relation to the point size. For example, for a 5 point width, the master character image would be scanned in half as many strokes as used for a 10 point width. When combined with a constant beam width in the display CRT, the result is a character width or point size in proportion to the number of scanning strokes.

Output pagination refers to the method used to generate a full page of typeset copy. The primary methods used are: (1) stroke, (2) line, and (3) page.

In operation, each stroke displayed on the face of the CRT is located in exactly he same position. No horizontal movement of the electron beam occurs at any time. A mechanically driven prism lays down each vertical slice of the character one at a time. A series of timing lines synchronizes movement of the prism with generation of each stroke.



The Mergenthaler 1010 imaging system.



The imaging system of the Linotron 505. Note that it is a hybrid: using a matrix to tell the CRT how a character should be generated.

The line method utilizes horizontal deflection of the electron beam to typeset a complete line and a mechanical system to advance the film or paper between lines. This method is much faster than the stroke method because electronic beam deflection is faster than mechanical action. However, the extra speed is achieved at the cost of a more expensive, larger CRT and more complicated circuitry to compensate for distortion of the electron beam as it moves away from the center of the tube.

The page method uses both horizontal and vertical deflection of the electron beam to set a complete area or page of type without any mechanical movement. The output film or paper is advanced only between pages. While the fastest typesetting method of all, it is also the most expensive.

The Fototronic CRT uses a combination of the line and page methods. It combines beam motion with motion of the output film or paper for both horizontal and vertical placement of characters. Horizontal character placement is accomplished by beam deflection across the full 11.5-inch width of the CRT display tube. In addition, the output film or paper is on a carriage that can be shifted sideways if a wider line is required.

There are several developments in technology and applications that will significantly affect the phototypesetting industry, although it is too early to predict the nature or extent of their impact.

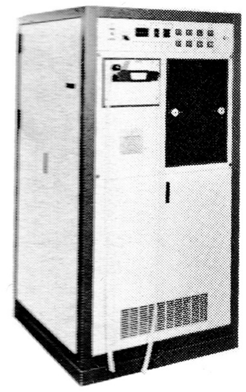
The input of data to computer typesetting systems will become more automated. Optical character recognition readers will find increasing acceptance and application over the next three to five years. ~~In the~~ late ~~1970's,~~ voice recognition techniques may also start to gain market acceptance. Creation of many microfilm information storage and retrieval systems during the next five years is expected to foster a demand for computer-input-microfilm recorders to provide a direct interface to microimaged data.

The Mergenthaler V-I-P, which stands for Variable Input Phototypesetter. It incorporates its own minicomputer.

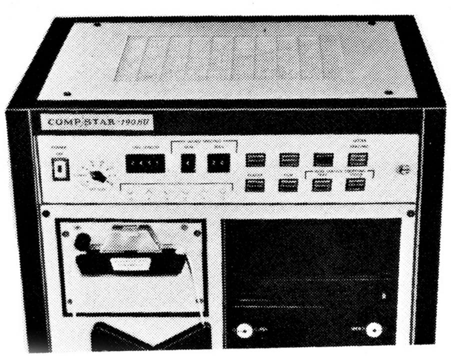
TOOLS OF THE TRADE

Photo-typesetting ©

CompStar



	Star 150	Star 190	Star 190H	Star 190HU	Star 190DL	Star 191
Cost						
Base price	$9,990	$11,990	$12,500	$12,990	$13,200	$18,990
Cost of Standard Type Masters	$60	$60	$60	$60	$60	$120
Input						
Form	Paper Tape	Paper Tape	Paper Tape	Paper Tape	Paper Tape	Paper Tape, Mag Tape
Level	6	6	6	6	6	6
Unjustified	Yes	Yes	Yes	Yes	Yes	Yes
Wire Service	Yes	Yes	Yes	Yes	Yes	Yes
Converts wire service	No	Yes	Yes	Yes	Yes	Yes
Requires keyboard	No	No	No	No	No	No
Requires computer	No	No	No	No	No	No
Reader type	Photo Electric	Photo Electric	Photo Electric	Photo Electric	Photo Electric	Photo Electric
Reader speed	200 cps	200 cps	200 cps	200 cps	200 cps	200 cps
Type						
Range (points)	5-24	5-24	5½-24	5½-24	5½-24	5-48
Typeface capacity	2	2	2	2	2	6-8
Characters/typeface	90*	90*	90*	90*	90*	110
Sizes on machine	1	1	1	1	2	Up to 15
Master	1	1	1	1	1	1
Functions						
Automatic space insertion	Yes	Yes	Yes	Yes	Yes	Yes
Automatic leader insertion	Yes	Yes	Yes	Yes	Yes	Yes
Kerning capability	No	No	No	No	No	Yes
Reverse leading capability	No	No	No	No	No	No
Intra-line face mixing	Yes	Yes	Yes	Yes	Yes	Yes
Intra-line size mixing	No	No	No	No	No	Yes
Character alignment	Base	Base	Base	Base	Base	Base
Justification:						
Logic	No	No	Yes	Yes	Yes	Yes
Hyphenless	Yes	Yes	Yes	Yes	Yes	Yes
Discretionary	No	No	Yes	Yes	Yes	Yes
Characteristics						
Maximum line length (picas)	33	33	33	33	33	45
Leading range & increment	0-31½/½	0-31½/½	0-31½/½	0-31½/½	0-31½/½	0-99½/½
8 pt, 11 pica lines per minute	150	150	150	150	150	150
Width of paper/film	To 8″	To 8″	To 8″	To 8″	To 8″	To 8″
Paper/film capacity	150′	150′	150′	150′	150′	150′
Master replacement time	2 Minutes	2 Minutes	2 Minutes	2 Minutes	2 Minutes	2 Minutes
Minimum letter spacing	1 Unit	1 Unit	1 Unit	1 Unit	1 Unit	.001
Minimum justification spacing	0 Units	0 Units	0 Units	0 Units	0 Units	.001
Size change technique	Lens	Lens	Lens	Lens	Lens	Lens
Type size control	Manual	Manual	Manual	Manual	Tape & Manual	Tape & Manual
Circuitry design	MSI & LSI	MSI & LSI	MSI & LSI	MSI & LSI	MSI & LSI	Integr. MSI & LSI
Light source	Xenon	Xenon	Xenon	Xenon	Xenon	Xenon
Width unit	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em	.001
Width change component	Electronic	Electronic	Electronic	Electronic	Electronic	Electronic
Character selection	Rotating Drum	Rotating Drum	Rotating Drum	Rotating Drum	Rotating Drum	Rotating Drum
Character exposure	Character Flash	Character Flash	Character Flash	Character Flash	Character Flash	Character Flash
Write-out method	Rotating Mirror	Rotating Mirror	Rotating Mirror	Rotating Mirror	Rotating Mirror	Rotating Mirror
Programmable logic	No	No	No	No	No	Programmable
Format storage	No	No	No	No	No	Standard
* Computer & Output Module	*30 pi optional					



left: operating unit CompStar 190HU

right: controls for CompStar 191

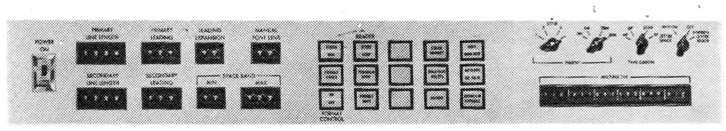
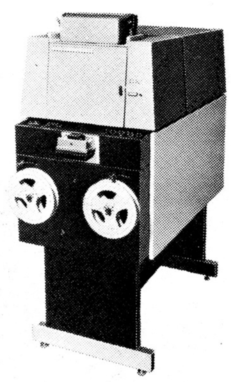
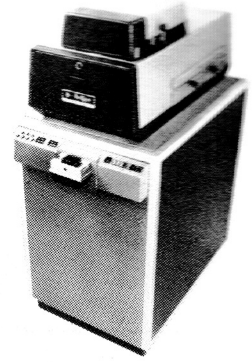


Photo-typesetting

TOOLS OF THE TRADE ©





	Graphic Systems, Inc. Typesetter	American Type Founders Photo Comp 20	Varityper AM 725	Varityper AM 747	Varityper AM 707	Varityper AM 744
Cost						
Base price	Under $14,000	$13,500	$17,900	$21,835	$11,950	$14,950
Cost of Standard Type Masters	Under $150	$187.50	$375	$375	$195	$295
Input	Paper Tape or					
Form	On-Line	Paper Tape	Paper Tape	Paper Tape	Paper Tape	Paper Tape
Level	2-Frame, 8 Level pa.	6, 7 or 8	6-7-8	6-7-8	6-7-8	6-7-8
Unjustified	—	Yes (Option)	Yes	Yes	Yes	Yes
Wire Service	—	Yes	Yes	Yes	Yes	Yes
Converts wire service	—	Yes (Option)	Yes	Yes	Yes	Yes
Requires keyboard	No	No	No	No	No	No
Requires computer	Yes	No	No	No	No	No
Reader type	Photoelectric	Photo Electric	Electro Mechanical	Electro Mechanical	Electro Mechanical	Electro Mechanical
Reader speed	70 cps	125 cps	50 cps	50 cps	50 cps	50 cps
Type						
Range (points)	6-36	5½-18	6-18	6-18 (½ pt incrmntt)	5-18	5-36
Typeface capacity	4	4	3		2	4
Characters/typeface	106	122	112	112	112	112
Sizes on machine	15	4	3	3	2	4
Master	Film Neg	Disc	Disc	Disc	Disc	Disc
Functions						
Automatic space insertion	Computer Controlled	No	Yes	Yes	Yes	Yes
Automatic leader insertion	Computer Controlled	No	Yes	Yes	Yes	Yes
Kerning capability	Computer Controlled	Yes	No	Yes	Yes	Yes
Reverse leading capability	No	No	No	No	No	No
Intra-line face mixing	Computer Controlled	Yes	Yes	Yes	Yes	Yes
Intra-line size mixing	Computer Controlled	Yes	Limited	Limited	Limited	Limited
Character alignment	Baseline	Baseline	Base	Base	Base	Base
Justification:						
Logic	Computer Controlled	Option	No	Yes	Yes	Yes
Hyphenless	Computer Controlled	Option	Yes	Yes	Yes	Yes
Discretionary	Computer Controlled	Option	Yes	Yes	Yes	Yes
Characteristics						
Maximum line length (picas)	47	33	45	45 0-99	33	33
Leading range & increment	Unlimited ½ pt.	0-31½/½	0-99/½ pt.	½	0-99/½	0-99/½
Newspaper lines per minute	50	20	20	30	40	50
Width of paper/film	2", 3", 4", 6", 8"	3", 4", 5¾", 6"	4", 6", 8"	4", 6", 8"	4" & 6"	4" & 6"
Paper/film capacity	150'	75'	150'/100'	150'/100'	150'/100'	150'/100'
Master replacement time	1 Minute	1 Minute	1 Minute	1 Minute	1 Minute	1 Minute
Minimum letter spacing	1/6 pt.	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em
Minimum justification spacing	1/6 pt.	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em
Size change technique	Optical Change	Disc Change	Lens Manual	Tape/Manual	Tape/Manual	Tape/Manual
Type size control	Tape	Manual	Manual	Auto/Manual	Auto/Manual	Auto/Manual
Circuitry design	Integrated Circuits	Integrated Circuits	Integrated	Integrated	Integrated	Integrated
Light source	Xenon	Xenon	Xenon	Xenon	Xenon	Xenon
Width unit	1/6 pt.	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em
Width change component	Computer	Punched Card	Core Memory	Core Memory	Core Memory	Core Memory
Character selection	Rotating Drum	Oscillating Disc	Rotating Disc	Rotating Disc	Rotating Disc	Rotating Disc
Character exposure	Flash	Character Flash	Character Flash	Character Flash	Character Flash	Character Flash
Write-out method	Fiber Optics Bndl.	Moving Carriage	Lens	Lens	Lens	Lens
	No	No	Yes	Yes	Yes	Yes
	No	No	Yes	Yes	Yes	Yes

* Computer & Output Module

Mergenthaler Co.
Dept. AMP
Mergenthaler Drive
Plainview, N.Y. 11803

ATF Type Division
Dept. AMP
200 Elmora Ave.
Elizabeth, N.J. 07207

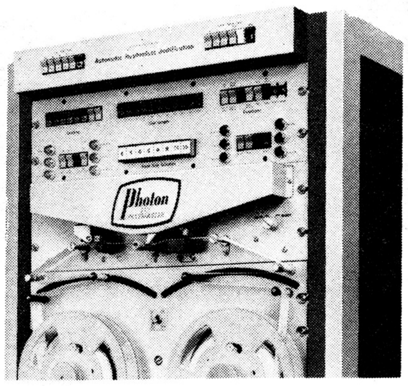
Photon, Inc.
Dept. AMP
355 Middlesex Ave.
Wilmington, Mass. 01887

Alphatype Corporation
Dept. AMP
7500 McCormick Blvd.
Skokie, Ill. 60076

Intertype Corporation
Dept. AMP
215 U.S. Highway 22
Watchung, N.J. 07060

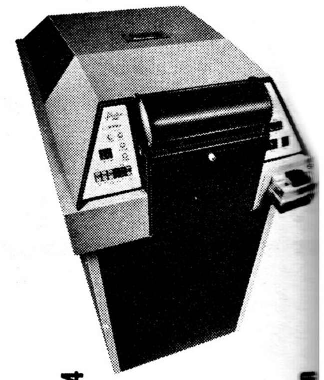
Singer/Friden
Dept. AMP
2350 Washington Ave.
San Leandro, Calif. 94577

Reprinted from the December, 1971, issue of *American Press* magazine.



left:
operating unit
Photon 713
Photon Pacesetter

right:
Photon Pacesetter



Fairchild	Photon 713-5 A-B	Photon 713-10/20/100	Photon 713-200	Photon 561	Photon 532	Photon Pacesetter 4	Photon Pacesetter 8
$12,000	$22,000 $28,350	$42,500 $47,500	$62,500	$46,000	$54,500	*	*
$275	$290	$290	$525	$1,025	$1,025	$325	$495
Paper Tape	Paper tape	Paper or Mag. Tape	Paper or Mag. Tape	Paper Tape	Paper Tape	Paper Tape	Paper Tape
6-7-8	6-7-8	6-7-8	6-7-8	6-8	6-8	6-7-8	6-7-8
Yes	No	No/Yes/No	Yes	No	No	Yes	Yes
Yes	Yes	Yes	Yes	No	No	Yes	Yes
No	Yes	No/Yes/No	Yes	No	No	Yes	Yes
No	No	No	No	No	No	No	No
No	No	No	No	Yes	Yes	No	No
Photoelectric	Photoelectric	Photoelectric	Photoelectric	Photoelectric	Photoelectric	Mechanical	Mechanical
400	500	500	1000	300	300	60	60
5-18	5-18/5-72	5-36	5-36	5-72	4½-72	5-72	5-72
2	4	8/8/4	4	16	32	4	8
108	96	96	96	90	90	112	112
2	2/8	8	8	12	23	*	*
Turret	Filmstrip	Filmstrip	Filmstrip	Disc	Disc	Disc	Disc
Yes	Optional	Optional	Optional	Computer	Computer	Yes	Yes
No	Optional	Optional	Optional	Computer	Computer	Yes	Yes
No	No	No	Yes	Yes	Yes	Yes	Yes
No	No	No	No	Yes	Yes	No	No
No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No	No	No	No	Yes	Yes	Yes	Yes
Base	Base	Base	Base	Base	Base	Base	Base
Yes	No	No	No	—	—	Yes	Yes
Yes	Yes	Yes	Yes	—	—	Yes	Yes
Yes	Yes	Yes	Yes	—	—	Yes	Yes
30	45	45	45	54	54	45/54	45/54
0-18; ½; 19-36; 1	0-31½; ½	0-31½; ½	0-31½; ½	0-127½; ½	0-127½; ½	0-499; ½	0-499; ½
35	40	40/40/100	200	25	25	50	50
3", 4", 5", 6"	4"-8"	4"-8"	4"-8"	4"-10"	4"-10"	4"-10"	4"-10"
100'	100'/50'	100'/50'	100'/50'	100'/50'	100'/50'	100'/50'	100'/50'
1 Minute	1 Minute	1 Minute	1 Minute	30 Seconds	30 Seconds	30 Seconds	30 Seconds
1/648"	1/36 em	1/36 em	1/36 em	1/640"	1/640	1/36 em	1/36 em
1/648"	4 Units	4 Units	4 units	Variable	Variable	Variable	Variable
Manual	Len Turret	Lens Turret	Lens Turret	Lens Turret	Lens Turret	Lens Turret	Lens Turret
Manual	Man./Tape	Man./Tape	Man./Tape	Tape	Tape	Man./Tape	Man./Tape
Integrated	Integrated	Solid State	Integrated	Integrated	Integrated	Integrated	Integrated
Xenon	Xenon	Xenon	Xenon	Xenon	Xenon	Xenon	Xenon
1/648"	1/36 em	1/36 em	1/36 em	1/640"	1/640"	1/36 em	1/36 em
Core Memory	Core Memory	Core Memory	Core Memory	Computer Tape	Computer Tape	Core Memory	Core Memory
Rotating Turret	Rotating Drum	Rotating Drum	Rotating Drum	Rotating Disc	Rotating Disc	Rotating Disc	Rotating Disc
Flash	Flash	Flash	Flash	Flash	Flash	Flash	Flash
Mirror and Lens	Moving Mirror	Moving Mirror	Moving Mirror	Moving Mirror	Moving Mirror	Moving Mirror	Moving Mirror
	Yes	Yes	Yes	No	No	Yes	Yes
	Yes	Yes	Yes	No	No	Yes	Yes

Photon 561

PACESETTER MODELS AND PRICES

FACE	SIZE	PRICE	FACE	SIZE	PRICE	FACE	SIZE	PRICE
4	x 4	$13,500	4	x 13	17,350	8	x 9	19,550
4	x 5	13,900	4	x 14	17,800	8	x 10	19,950
4	x 6	14,300	4	x 15	18,250	8	x 11	20,450
4	x 7	14,700	4	x 16	18,700	8	x 12	20,900
4	x 8	15,000	8	x 4	17,500	8	x 13	21,350
4	x 9	15,550	8	x 5	17,900	8	x 14	21,800
4	x 10	16,000	8	x 6	18,300	8	x 15	22,250
4	x 11	16,450	8	x 7	18,700	8	x 16	22,700
4	x 12	16,900	8	x 8	19,100			

Prices and specifications subject to change without notice

TOOLS OF THE TRADE

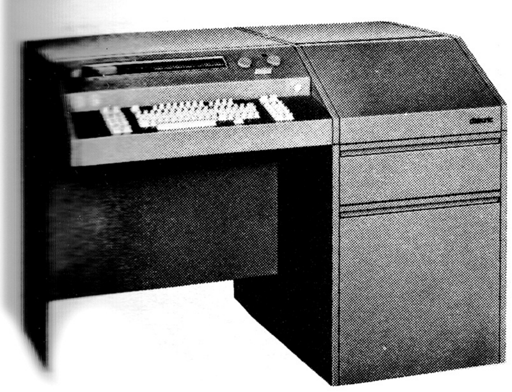
Photo-typesetting

©

right:
Singer Photomix
and Justotext

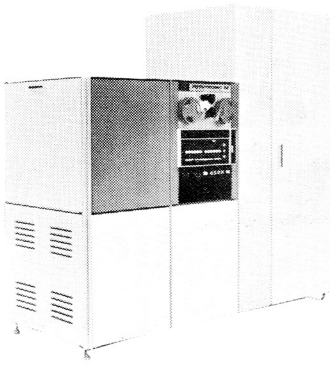
	Berthold Diatronic	Singer Photomix 8000	Singer Photomix 8100	Singer Photomix 8200	Singer Justotext 70	Singer Justotext 71
Cost						
Base price	$35,450	$20,950	$24,500	$26,500	$5,950	$6,950
Cost of Standard Type Masters	$450	$145	$145	$145	$70	$70
Input						
Form	Direct or Paper Tape	Paper Tape	Paper Tape	Paper Tape	Paper Tape	Paper Tape
Level	Not Yet Established	6	6	6	7	6/7
Unjustified	No	Yes	Yes	Yes	No	Yes
Wire Service	No	Yes	Yes	Yes	No	Yes
Converts wire service	No				No	No
Requires keyboard	No	No	No	No	Yes	No
Requires computer	No	No	No	No	No	No
Reader type	Photoelectric	Photoelectric	Photoelectric	Photoelectric	Photoelectric	Photoelectric
Reader speed	200	70	70	70	300	300
Type						
Range (points)	6-20	5-18	5-18	6-36	5-13	5-13
Typeface capacity	8	4	4	4	2	2
Characters/typeface	126	102	102	102	90	90
Sizes on machine	15	9	9	15	1	1
Master	Glass Neg	Filmstrip	Filmstrip	Filmstrip	Filmstrip	Filmstrip
Functions						
Automatic space insertion	Yes	Yes	Yes	Yes	No	No
Automatic leader insertion	Yes	Optional	Yes	Yes	No	No
Kerning capability	Yes	Yes	Yes	Yes	No	No
Reverse leading capability	Yes	No	No	No	No	No
Intra-line face mixing	Yes	Yes	Yes	Yes	Yes	Yes
Intra-line size mixing	Yes	Yes	Yes	Yes	No	No
Character alignment	Baseline	Base	Base	Base	Base	Base
Justification:						
Logic	Yes	Yes	Yes	Yes	No	No
Hyphenless	Yes	Yes	Yes	Yes	No	No
Discretionary	No	Yes	Yes	Yes		
Characteristics						
Maximum line length (picas)	72	47	47	47	33	33
Leading range & increment	0-72/ 1/16MM	0-31½; ½	0-127½; ½	0-127½; ½	0-31½; ½	0-31½; ½
8 pt. 11 pica lines per minute	13	30	30	30	30	30
Width of paper/film	12"x12"	2", 3", 6", 8"	2", 3", 6", 8"	2", 3", 6", 8"	2", 3", 4", 6"	2", 3", 4", 6"
Paper/film capacity	Sheet Only	150'	150'	150'	150'	150'
Master replacement time	2 Seconds	2 Minutes	2 Minutes	2 Minutes	2 Minutes	2 Minutes
Minimum letter spacing	44 Pt.	1/36 em	1/36 em	1/36 em	1/6 em	1/6 em
Minimum justification spacing	1 Pica	Variable	Variable	Variable	1/6 em	1/6 em
Size change technique	Lens	Tape	Tape	Tape		
Type size control	Automatic	Tape	Tape	Tape		
Circuitry design	Integ. Circuit	Integrated	Integrated	Integrated	Integrated	Integrated
Light source	Xenon	Xenon	Xenon	Xenon	Xenon	Xenon
Width unit	64 to Em	1/36 em	1/36 em	1/36 em	1/6 em	1/6 em
Width change component	Plug	Solid State Memory	Solid State Memory	Solid State Memory	Gear	Gear
Character selection	Stationary Grid	Rotating Drum	Rotating Drum	Rotating Drum	Rotating Drum	Rotating Drum
Character exposure	Flash	Flash	Flash	Flash	Flash	Flash
Write-out method	Mirror	Fiber Optics	Fiber Optics	Fiber Optics	Moving Lens	Moving Lens
Programmable logic	No	No	Yes	Yes	No	No
Format storage	No	No	Yes	Yes	No	No

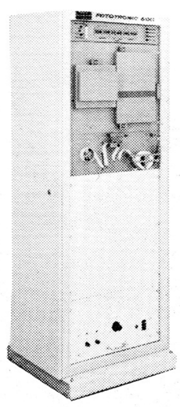
* Computer & Output Module



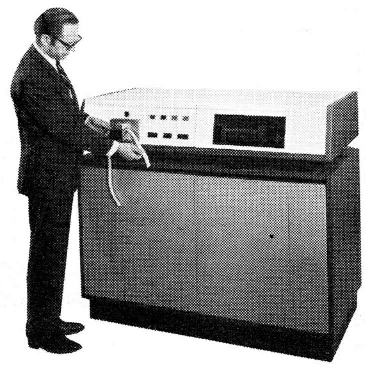
left:
Berthold
Diatronic
and keyboard

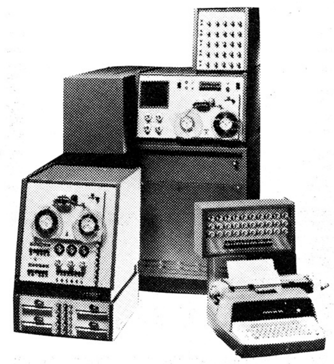
right:
Singer
Photomix



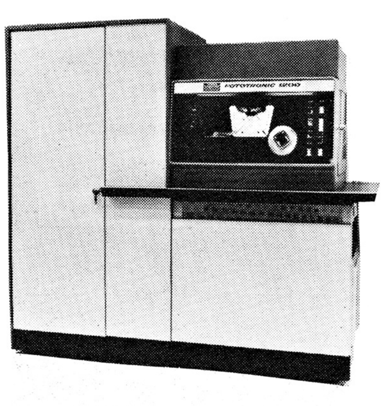


left:
H-I TXT
and 600
right:
Merg VIP
Alphatype

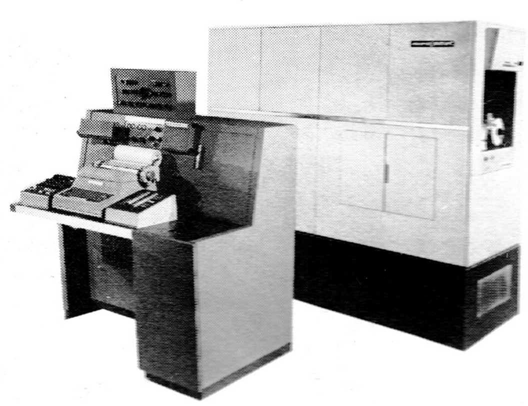


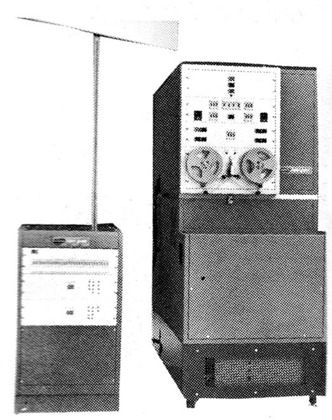


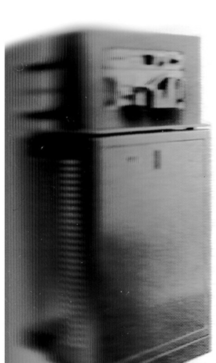
Harris-Intertype 1200	Harris-Intertype TXT	Harris-Intertype 600	Mergenthaler Linofilm KE-28	Mergenthaler Linofilm Super-Quick	Mergenthaler V-I-P	Alphatype
$65,000	$54,500	$11,500	$52,400	$38,250	$19,500	$16,500
$875	$875	$150	$275	$175	$120/$180	$65
Paper Tape	Paper Tape (Mag. Tape Optional)	Paper Tape	Paper Tape	Paper Tape	Paper Tape	Mag or Paper Tape
8	6-8 (9)	6	15	6	6 (7 & 8 opt.)	10 (Mag) 6-7 pap
No	Yes	Yes	No	No	Yes	Yes
No	Yes	Yes	No	Yes	Yes	No
No	Yes	Yes	No	No	Yes (Option)	No
Yes	No	No	Yes	No	No	Yes
Yes	No	No	Yes	No	No	No
Electro Mechan.	Photoelectric	Photoelectric	Electro-Mechanical	Photo Electric	Photo Electric	N/A
60	125	90	40 cps	250 cps	60 cps	N/A
5-72	5-72	5-24	6-54	4¾-18	6-48	5-18
10 or 15	10 to 15	6	28	8	6	10
120 or 80	80, 97, 120	120	88	92	96	168
19	12	6	15	4	16	Up to 10
Disc	Disc	Disc	Glass Negative	Glass Negative	Film Font	Film Neg
Yes	Yes	Yes	No	No	Yes (w/Option)	Yes
Yes	Yes	Yes	No	No	Yes (w/Option)	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	No	No	No	No	Yes (Manual)
Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	No	Yes
Base	Base	Base	Optical Center	Baseline	Baseline	Baseline (or cntred)
Yes	Yes	Yes	No	No	Yes	No
			No	No	Yes	No
No	Yes	Yes	No	No	Yes	Yes
51	42	42	42	45	36	66 picas
0-63¾; ¼	0-99.95; 1/10	0-42; ½	0-48/1 pt.	0-99¾/½ pt.	0-63½/½ pt.	0-39½/½
30	150/90	50	20	40	32	15
3¾", 5¾", 7¾",	3¾"5¾"7¾"9¼"	3¾", 5¾", 7¼"	4", 6", 8"	4", 6", 8"	6¾"	12"
100'	475'/200'	150'/100'	100'	100'	100'	12x12" Sheets
1 Minute	1 Minute	1 Minute	20 Seconds	30 Seconds	10-20 Seconds	2-5 Seconds
1/32 em	1/32 em	1/64 pica	1/36 em	1/18 pt.	1/18 em	1/18 em (& or 1/36
1/64 pica	1/64 Pica	1/64 pica	4 Units	1/18 pt.	1/18 em	1/18 em (& or 1/36
Zoom Lenses	Lens Turret	Disc.	Optical Change	Grid & Optical Chge	Zoom Lens	Grid Change
Tape	Tape	Tape	Tape	Manual & Tape	Tape	Automatic
Integrated	Integrated	Integrated	Electro-Mechanical	Solid State	Integrated Circuits	Solid State
Xenon	Xenon	Xenon	Xenon	Xenon	Xenon	Xenon
1/32 em	1/32 em	1/64 Pica	1/18 Unit	Points	1/18 em	1/18 em (& or 1/36
Disc Code	Core Memory	Core Memory	Width Card	Width Plug	Core Memory	Style Card
Rotating Disc	Rotating Disc	Rotating Disc	Shutter	Wedges & Shutter	Oscillating Drum	Character Flash
Flash	Flash	Flash	Flash	Shutter	Flash	Character Flash
Moving Output	Moving Mirror	Moving Mirror	Moving Mirror	Moving Mirror	Rotating Mirror	Lens
No	Programmable	Programmable	No	No		No
No	Standard	No	No	No		No

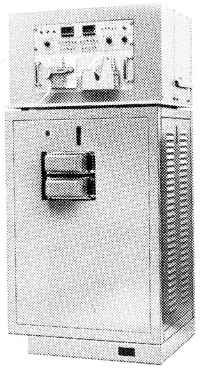


left:
H-I 1200
right:
Merg Linofilm
and Super Quick



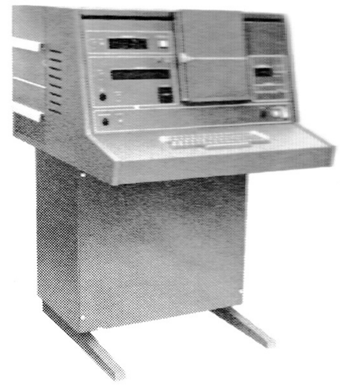






left:
CompuGraphic 2900 and 4900 series

right:
ACM 9000.
CompuWriter



Compugraphic 2961TL	Compugraphic 2971TL	Compugraphic 2970	Compugraphic 4961TL	Compugraphic 4962	Compugraphic ACM 9000/9001	Compugraphic CompuWriter
$7,950	$7,950	$4,500	$11,750	$4,950	$19,950/13,950	$6,950
$60	$60	$60	$90	$90	$350	$60
Tape	Tape	Tape	Tape/Kybd.	Tape	Tape/Kybd.	Keyboard Direct
6	7	7	6	6	6/8	No
Yes	Yes	No	Yes	No	Yes	N/A
Yes	No	No	Yes	No	Yes	N/A
No	No	No	Optional	No	No	N/A
No	Yes	Yes	No	No	Included	Included
No	No	No	No	Yes	No	No
Photoelectric	Photoelectric	Photoelectric	Photoelectric	Photoelectric	Photoelectric	N/A
125	125	125	125	125	125	N/A
5-24	5-24	5-12	5-24	5-12	5-72	5½-24
2	2	2	4	4	4	2
90	90	90	90	90	102	96
2	2	1	4	2	12	2
Filmstrip	Filmstrip	Filmstrip	Filmstrip	Filmstrip	Filmstrip	Filmstrip
Yes	Yes	Yes	Yes	No	Yes	No
Optional	Optional	No	Yes	No	Yes	No
No	No	No	Yes	No	Yes	No
No	No	No	No	No	No	No
Yes	Yes	Yes	Yes	Yes	Yes	No
No	No	No	Yes	No	Yes	No
Base	Base	Base	Base	Base	Base	Base
Yes	Yes	No	Yes	No	Yes	No
Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	No	Yes	Yes
45	45	33	45	33	45	45
0-31½; ½	0-3½; ½	0-31½; ½	0-31½; ½	0-31½; ½	0-99; ½	0-31½; ½
25	25	30	25	50	25	Keyboard
2″, 3″, 6″, 8″	2″, 3″, 6″, 8″	2″, 3″, 6″	2″, 3″, 6″, 8″	2″, 3″, 6″, 8″	2″, 3″, 6″, 8″	2″, 3″, 6″, 8″
150′	150′	150′	150′	150′	150′	150′
1 Minute	1 Minute	1 Minute	1 Minute	1 Minute	1 Minute	1 Minute
1/18 Em	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em
1/18 Em	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em	1/18 Em
Strip & Lens	Strip & Lens	Strip	Strip Layout	Strip Layout	Lens	Filmstrip
Manual	Manual	Manual	Kybd./Tape	Tape	Kybd./Tape	Manual
Solid State	Solid State	Solid State	Solid State	Solid State	Integrated	Integrated
Xenon	Xenon	Xenon	Xenon	Xenon	Xenon	Xenon
1/18 em	1/18 em	1/18 em	1/18 em	1/18 em	1/18 em	1/18 Em
Gear	Gear	Gear	Plugs	Gear and Computer	Width Tapes	Plug
Rotating Wheel	Rotating Wheel	Rotating Wheel	Rotating Wheel	Rotating Wheel	Rotating Wheel	Rotating Wheel
Flash	Flash	Flash	Flash	Flash	Flash	Flash
Moving Lens	Moving Lens	Moving Lens	Moving Lens	Moving Lens	Move Material	Moving Lens
No	No	No	No	No	Programmable (option)	
No	No	No	No	No	Option	

Berthold Fototype Company
Dept. AMP
375 Allwood Rd.
Clifton, N.J. 07013

Varityper Typesetting Systems
Dept. AMP
11 Mt. Pleasant Ave.
East Hanover, N.J. 07936

Fairchild Graphic Equipment
Dept. AMP
221 Fairchild Ave.
Plainview, N.Y. 11803

Mergenthaler Co.
Dept. AMP
Mergenthaler Drive
Plainview, N.Y. 11803

ATF Type Division
Dept. AMP
200 Elmora Ave.
Elizabeth, N.J. 07207

Photon, Inc.
Dept. AMP
355 Middlesex Ave.
Wilmington, Mass. 01887

Alphatype Corporation
Dept. AMP
7500 McCormick Blvd.
Skokie, Ill. 60076

Intertype Corporation
Dept. AMP
215 U.S. Highway 22
Watchung, N.J. 07060

Singer/Friden
Dept. AMP
2350 Washington Ave.
San Leandro, Calif. 94577

Star Parts
Dept. AMP
South Hackensack, N.J. 07606

Compugraphic Corporation
Dept. AMP
80 Industrial Way
Wilmington, Mass. 01887

Graphic Systems, Inc.
217 Jackson St.
Lowell, Mass. 01852

(The following article is excerpted from a speech given by Michael Stonehouse, President of Advanced Keyboarding Systems. It deals with the training of input operators.)

Over the years, one of the most important areas of composition input, has largely been ignored by the graphic arts community: the systematic training of new operators or the improvement in skill levels of older operators. My experience has been that management, often satisfied with average work, does become attentive when the statement is made that output can be increased by as much as twenty five per cent. But, add the fact that their operators must be re-trained at some degree of cost and the idea is no longer attractive. Training appears to be an intangible. Unlike a piece of equipment or consumable supplies there is no real price tag on performance in many organizations.

No matter how automated the input process becomes, someone, somewhere must still hit a key. If you can get that someone to hit more keys, correctly, in less time, you're input costs are going down. This is how it will be until the day electrodes are planted in the brain and we all go online to some gigantic computer.

From about 1964 on several organizations sprung up (and then just as promptly sprung dowm) to meet the need of publishers to improve the input process. Initially the larger plants started training and re-training, especially those with data processing systems. Personnel were removed from the production stream for a very minimal amount of time and evaluated and trained.

Production errors can run up to twenty five per cent of cost. Keyboard training, or a better phrase may be "skill improvement," cuts errors. An operator should be able to produce 15,000 to 16,000 keystrokes per hour on straight matter input and approximately 7,000 to 8,000 per hour on tabular material.

Management may feel it is faster to correct an error at the paste-up table. I say it is faster still and cheaper to not have that error in the first place. Think about it: if your operators made less errors, what effect would it have on production profitability... We also train the trainers. Your supervisory level is also important in the input process.

We normally take about four weeks in an installation of five or less operators. We improve skill levels and thereby lower error rates. That's what training is all about.

3. Keyboard to tape systems

To understand the wide variety of keyboards available today, and to appreciate some of the trends toward new equipment concepts, it is useful to have some background on the general development of keyboard systems as used in the typesetting environment. For our purposes here keyboards, keyboard systems, keyboard machines and keyboard devices are defined as those pieces of machinery which create a machine readable record as their primary output. This record is then subsequently processed by some other device or system. Keyboard elements are those subassemblies consisting of at least 64 keys mounted on a frame.

Initially, virtually all typesetting was done on hot metal linecasters made by Harris-Intertype and Merganthaler. The operator used a keyboard component that was an integral part of the linecaster, and as information was keyed, a line of brass type mats was assembled to form a line from which a lead slug was cast. These lead slugs were then locked in a chase and this formed a complete galley of information ready to be printed. The maximum line length was limited by the capacity of the linecaster and was usually 30 picas. To achieve uniformity of line, it was necessary for the operator to key sufficient charaters to fill the line (supply enough characters to form a complete slug). On the other hand, if too many characters were keyed, the machine stopped due to an overset condition. This "enough but not too many" measure (called the hot zone) is simply a method of telling the operator when enough characters have been keyed to form a line. Once the hot zone was reached, it was up to the operator to determine how to end the line--to either finish the word, or to hyphenate.

Three major events moved typesetting away from the use of manual systems to the use of modern phototypesetting devices of today:

1) The first significant event to influence typesetting procedure was the demonstration that linecaster could be adapted to operate from punched paper tape readers. This permitted the tape to be made elsewhere on relatively inexpensive keyboard systems and then processed by the linecaster. Three major advantages were:

a) the tape could be prepared by people with less skill than a linecaster operator

b) the keying speed was faster when only punching tape

c) the linecaster could operate at its maximum speed, hour after hour.

The use of independent keyboard systems operating a tape driven linecaster significantly increased the effective "throughput" (or characters per dollar) of the system.

Several manufacturers offered special keyboard systems to serve this growing market. The first such devices were blind counting keyboards which produced justified tape. In use, both the length of the line to be set and the size of the type to be used was determined and the keyboard device adjusted for these parameters. As the operator keyed material into tape, an internal counting mechanism kept track of how much of the line had been consumed. When the hot zone had been reached, an indicator informed the operator that it was time to end the line, and the operator had to either finish the word or hyphenate, and insert a line end code. These blind keyboard systems consisted of a keyboard element mechanically connected to a paper tape punch, with a counting mechanism included. The operator had no visibility of the material being keyed, except to read and translate the code holes punched in the tape. In an attempt to furnish the operator with visibility of keyed material, some manufacturers connected tape punches and counting mechanisms to typewriters, and offered hard copy counting keyboards. These hard copy systems were more expensive, and in general they found their best application in training new keyboard operators or in preparing complex material.

2) The second event concerned the use of computers, which mostly affected high volume typesetting, such as newspapers. It was found that operators could key material up to 50 per cent faster if they did not have to concern themselves with "line end decisions". By switching off the counting devices in the keyboards, the operator could key non-justified tape. This non-justified tape was then fed into a special purpose computer, which had been programmed to assemble the characters into a specific line length. The computer also contained a set of logic rules to govern hyphenation. The computer then read the non-justified tape, examined each character to determine how much space in the line it would consume, hyphenated words if necessary, and produced a justified tape to operate the linecaster. Compugraphic was the pioneer in the field of computerized typesetting, and the Justape and Justape Jr. led the field in competition with IBM. The application of the computer to the typesetting environment permitted an important increase in keying speed, resulting in an effective lower keying cost. Manufacturers offered both blind and hard copy keyboard systems to serve this market application, although in many cases these machines were simply counting keyboards with the counting mechanisms removed.

These two events greatly increased the effective performance of hot metal typesetting. The first event (independent tape controlled operation) removed the human limitation and allowed the linecaster to operate at its maximum speed; the second event (computerized processing of non-justified tape) eliminated the concern for line end decisions and allowed the human to key at appreciably faster rates. For comparison, a good linecaster operator could key at approximately 6,000 characters per hour, while a good keyboard operator using a non-counting keyboard could reach rates of 18,000 characters per hour. Thus the use of non-counting keyboards combined with a typesetting computer achieved a three times increase in typesetting

throughout. In addition, the requirement for highly skilled operators was reduced, which therefore lowered the cost of keyboarding.

3) The third event to consider was a basic change in printing technology and the resultant impact on typesetting. Hot metal linecasters prepared lines of type, later assembled into galleys, which were used with letterpress or sterotype rotary printing equipment.

However, raised type was not usable in an offset press, so an intermediate step was required between the assembled typeset galley and the offset plate. Most users simply ran a "repro copy" from the raised type, photographed it, and used this negative to make the offset plate.

Phototypesetting was born with the development of machines using photo flash techniques to record the selected character image on a piece of film or paper. This output film or paper then became the equivalent of the typeset galley. The character images were selected from font discs or grids through which the light was flashed and the size of the character image could be altered by choosing lenses of different sizes, which finally focused the image on the film. Initial phototypesetters were functional replacements of the hot metal machines and, therefore, the preparation of input tape was the same for either hot metal or phototypesetters.

Subsequent phototypesetters offered far more flexibility with respect to font size and the number of fonts available. This increased the complexity of keyboarding, and has given rise to more sophisticated keyboard systems to produce this tape. The role of the computer has also expanded, and in addition to performing the simple hyphenation-justification tasks, the computer can now manage many of the phototypesetter functions.

In general, the more straightforward phototypesetters manufactured today have the hyphenation-justification computer included, and consequently virtually any kind of tape is acceptable. These machines are mostly used in straight matter text environments, such as the production of newspapers. The more sophisticated phototypesetters, which require the use of justified tape, are usually matched with the complex counting keyboards, or with computer systems.

Today, a bewildering selection of equipment is available. The user must choose between counting or non-counting keyboards, a host of typesetting computers, and typesetters that accept both justified and non-justified tape. New keyboard systems and computer systems introduce the question of recording media — magnetic tape, punch tape, printed tape, punch cards — are all available, ~~and they all have their place~~. As the number of options and permutations proliferate, it becomes increasingly important to understand the entire system, and its application. This "system appreciation" is imperative before an intelligent recommendation can be made relative to the phototypesetter and its attendant keyboard devices.

Recording Techniques

All recording techniques in use today are based on the absence or presence of a recording "bit". A bit, by definition, is a Binary Digit, and binary digits

are the fundamental units of a numbering system which uses 2 as a Radix. This base 2 system (using the "0" and "1" as the digits) is particularly applicable to recording schemes, since these two digits can be stored or recorded by a variety of mechanical or electronic devices. For example, relay contacts can be open or closed, a pulse can be absent or present, a magnetic field can be polarized north or south, a light can be off or on, etc.

Different numerals, alphabetic characters, or symbols can be recorded by assembling these bits in various combinations, called codes. The number of different codes available in any system is a function of the number of levels used - a level corresponding to a significant place in the system. For example, a code system using 5 levels has a maximum number of 32 code combinations. A code system using 6 significant places or levels offers 64 possible combinations, and so on. The number of possible code combinations is limited only by the number of levels or significant places used.

Since our concern is with typesetting, our attention will focus on the code combinations most commonly used by typesetting equipment. The original code system was developed by the Teletype Corporation, and is referred to as a TeleTypeSetter, or TTS code. Six levels are available, so the system offers 64 codes. These codes are punched in paper tape, with a hole being equal to "1" and a no-hole being equal to "0".

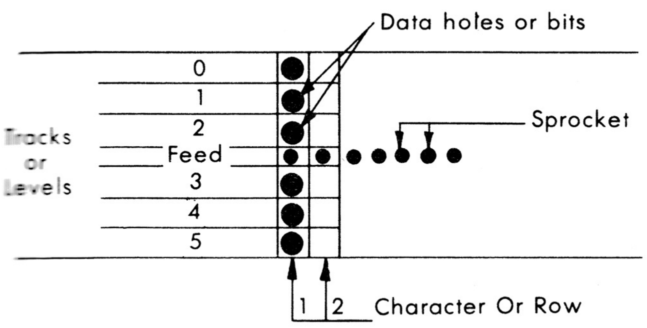
TTS tape is seven-eighths inches wide, and each of the data holes or bits is .072 inches in diameter. The sprocket hole is .046 inches in diameter, and while the primary use of this sprocket hole is to mechanically move the tape through the punch or reader, it also serves as a reference or timing bit to identify a character position in the tape. Character density is 10 characters per inch. Tracks are numbered 0 thru 5 (some manufacturers number the tracks 1 thru 6) and the sproket hole is in the center of the tape. All the bits that constitute a character are punched at the same time, along with the sprocket hole.

As mentioned above, a 6 level TTS code set offers 64 unique code combinations. Since a typesetter may contain over 100 characters in any font, plus 10 to 20 control codes, it is necessary to find some way to expand the number of useful codes available. This is done by using a "precedence" technique. When a precedence code is punched in the tape, it defines the meaning of all subsequent codes. The TTS system uses "shift" and "unshift" as precedence codes. While this does not change the number of unique combinations in the system, it does increase the number of useful codes, since any given bit combination can now have two meanings. For example, in the shift case, a hole in track 0, 1 is the numeric character "⅜". In the unshift case the same hole combination is the numeric character "3". Of the 64 codes in the TTS system, 2 are dedicated as precedence codes, one is the rub-out code and one is the tape feed code, resulting in 60 codes in the shift case and 60 in the unshift case, or 120 in all. Some codes, like elevate, return, thin space, etc., are the same in either the shift or unshift condition.

Some systems use a third precedence code (sometimes called red ribbon shift or control case shift) which allows 59 codes in each case, or 177 useful codes.

Recording Media

Paper tape is one of the original recording media. The paper itself is usually furnished in 1000 foot rolls, and is normally 2 ½ to 4 mils in thickness. Paper tape is available in standard widths of eleven-sixteenths inches, seven-eights inches and 1 inch. While the actual recording format is standard the world over (data holes .072 inches, sprocket holes .046 inches, holes on one-tenth inches centers) there are a number of methods used to number the tracks. In addition, some schemes use the sprocket hole on a line tangent with the date holes. The scheme used will vary with industry and application, and virtually any tape width will be found in any industry. In general, the primary applications of paper tape are:



eleven-sixteenths inches wide	5 level communications
seven-eighths inches wide	6 level typesetting
seven-eights inches wide	7 level data processing
one inch wide	8 level data processing

Paper tape is widely used due to its low cost, coupled with the modest cost of punches and readers. A 1000 foot roll of tape costs approximately $1.00 and will contain 120,000 characters. The cost of the punches and readers will vary with the operating characteristics and quality, with punches of the 15-30 characters per second vaiety costing $350-600 and ranging up to $2500 to $9000 for punches operating at speeds of 150 to 300 characters per second. Readers range from $250 to $500 for speeds of 15-30 characters per second. In general, paper tape finds its most popular application in those areas where the recording and reading rate is not high, and low cost is an important factor.

MagneticTape

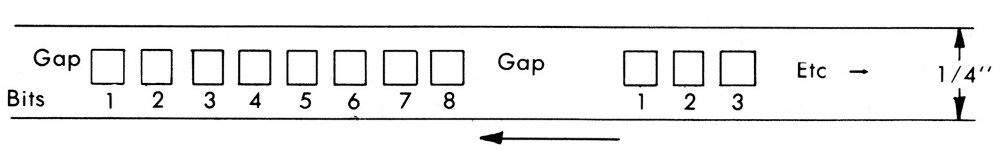
This concept of recording and retrieving information was pioneered by the data processing industry, and was designed to satisfy the need for fast input of data to a computer. The tape is usually furnished in lengths of 2400 feet (wound on a 10 inch reel) and is ½ inches wide by 1 ½ mils thick. A reel of tape costs around $35, but the information on the tape can be erased and the tape reused many times. As with paper tape, the characters are made up of a pattern of bits. The bits are represented by reversals in magnetic flux direction. This is done by moving the tape past an electromagnet (called a write head) and reversing the flow of current at the time a bit is to be recorded. Heads are arranged across the tape, with one head for each track or level. Information is recorded by the write head, and is retrieved by the read head, both of which are contained in the tape deck. Magnetic tape permits a far higher read-write rate as well as a higher character density than does paper tape. Today, the most common kinds of tape formats are:

7 track 200, 556, or 800 characters per inch (CPI)
9 track 800 CPI
9 track 1600 CPI (requires special read-write techniques)

The tape is moved past the read-write head at a constant speed during the writing or reading operation. The tape stops in the gaps between blocks. As the tape is read, a flux change in any of the tracks (or any combination of tracks) signifies the presence of a character. This makes the tape "self clocking" and eliminates the need for sprocket bits or timing bits to be recorded along with the character. The speed at which the characters can be recorded or retrieved (transfer rate) is a function of the character density (characters per inch or CPI) and the speed of the tape (inches per second or IPS). In a system using a tape speed of 40 inches per second, and a character density of 800 char per inch, the effective transfer rate is 40 IPS X 800 CPI or 32,000 characters per second, either read or write. Tape drives are currently available with speeds from 7,000 characters per second up to 180,000 characters per second. Mag tape drives are usually furnished with both read and write electronics. Depending upon the characteristics of the unit, a mag tape drive may cost anywhere from $4,000 to $40,000. These units usually find application in those environments where large amounts of data must be recorded or retrieved at high speeds, and where prime cost is not a significant factor, due to large data volume.

New lower cost tape drives (called incremental units) are now being offered to bridge the gap between the slow rates of paper tape devices and the extremely fast speeds of the magnetic tape drives discussed in above. These units record information on magnetic tape in a computer compatible format, however, in place of recording a block of data at once, they record a single character at a time. The recording can be done at any random rate up to the maximum, and the tape increments (moves) one character position for each character recorded, thus the name incremental. Generally they accept data at rates up to 300 characters per second, and the tape can then be loaded on a computer and read at maximum computer speeds. Some incremental magnetic tape units have both read and write functions, and typically "slow-read" the tape at rates up to 6,000 char per sec. These units sell for around $5,000 to $10,000, depending upon their characteristics, and are generally suited for applications where the information is recorded at fairly low speeds and read into a computer at high speed.

Another approach to the problem of low cost recording coupled with fairly fast reading speeds is based on the use of ¼ inch magnetic tape. This tape is similar to that used in home entertainment systems, with an important difference being the characteristic quality of the oxide coating. As before, characters are made up of groups of bits, and (like ½ inch mag tape) the bits are recorded by changing the flux direction as the tape moves past the read



A representation of seven track magnetic tape.

head. Bit patterns are recorded sequentially in tracks. The tape pattern provides a start-stop gap between characters, so that the system may record and read information a character at a time. Generally these systems are all based on an 8 level code, thus 8 bits are always in the string. The system is self clocking, so no sprocket or timing bits are recorded. The recording density can be as high as 800 bits per inch, but since the characters are sparated by gaps, the effective density is around 40 characters per inch. These units offer recording rates as high as 1600 char per sec. The price of a combined read-write unit is approximately $3,000.

Magnetic cassettes also evolved out of the home entertainment field, and were pioneered by Philips-Norelco. They are extremely easy to handle, and are very small in size considering the amount of information they can store. In principle, they are identical to the ¼ inch mag tape machines in that they record the bits in serial strings, with gaps between characters. Cassettes use tape only ⅛ inches wide. They can store up to 80,000 characters in a single cassette, and the tape is re-usable many times. The cost of a single cassette varies from $3 - $12. Cassettes are widely touted as the replacement devices for punched paper tape, and there are examples where the cost of the recording and reading units appear competitive with punched tape. A unit combining both read and write functions (such as the Sykes unit) may be priced as low as $750, and offers write speeds of up 500 char per sec. Their primary disadvantage seems to be the lack of an industry wide standard governing the record-format. Various manufacturers of cassette equipment may use different track-bit-code allocations, which means that cassettes may not be interchangable between devices made by different companies.

While the term cassette (by popular definition) means the Phillips-Norellco style, more and more companies are offering their own unique versions. IBM uses a special cassette on their MT-ST-MT-SC equipment, where the tape is ⅝ inches wide and is moved by means of sprocket holes punched in the edge of the tape,similar to motion picture film. Characters are recorded in parallel across the tape, similar to punched paper tape. Invac offers a special cassette using ¼ inch magnetic tape, where the tape moves from reel to reel, and the characters are recorded in bit sequential fashion.

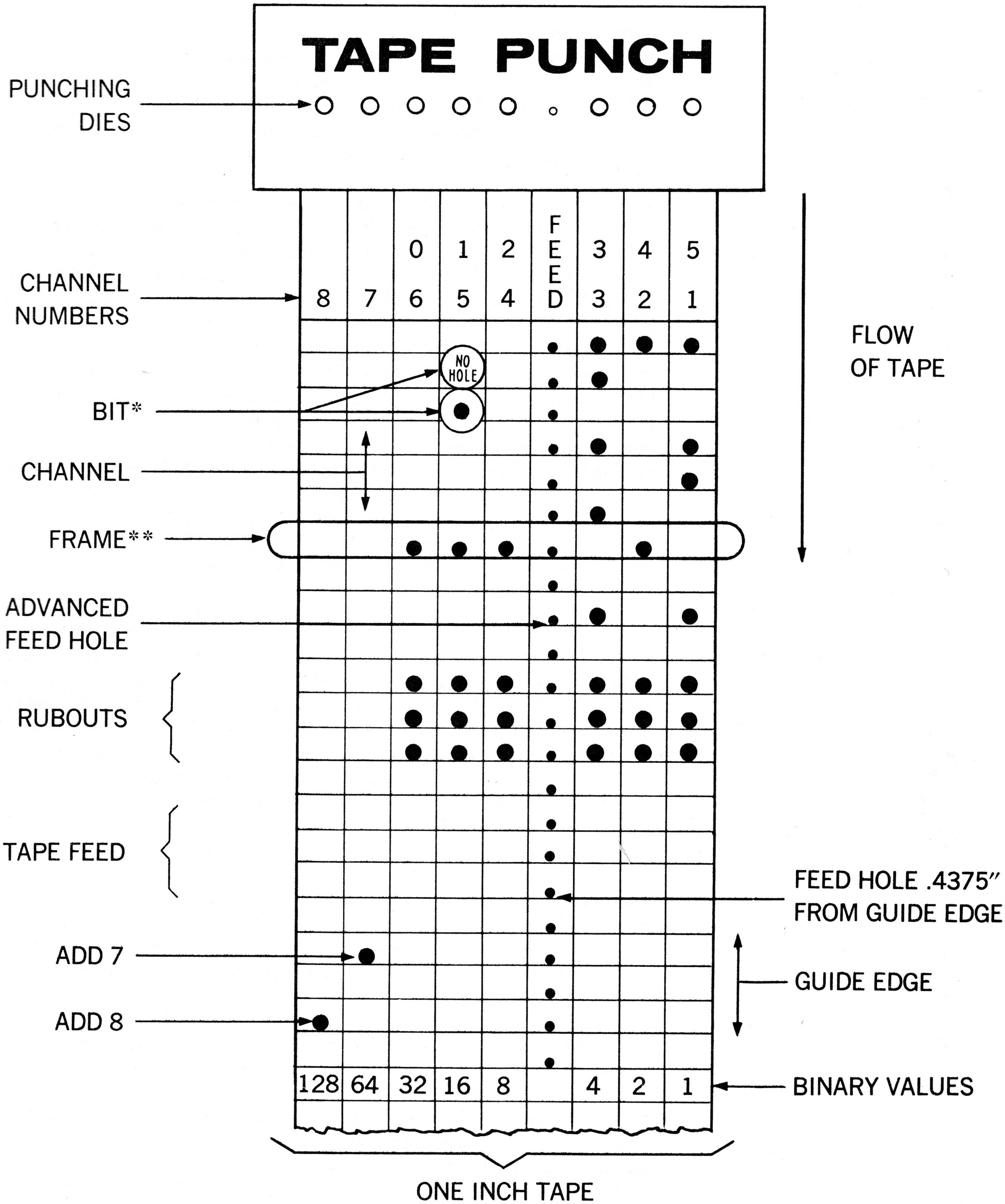
Keyboard Primer

This section deals with keyboard systems that are now in common usage. Some of these keyboards have been available for many years, while others are relatively new. It is impossible to compare every feature of every keyboard to its competitor, so this section is intended to give an overview of keyboards currently in use.

Keyboard element — For hard copy devices, this means the kind of typewriter used. For blind devices, this refers to the keyboard component.

Secretary shift — This defines the shift and unshift configurations of the keyboard element. Some manufacturers use a separate key for both shift and unshift commands with the attendant code generated as either key is depressed. Secretary shift commonly means that the shift code is generated when the key is depressed, the unshift code when the key is released.

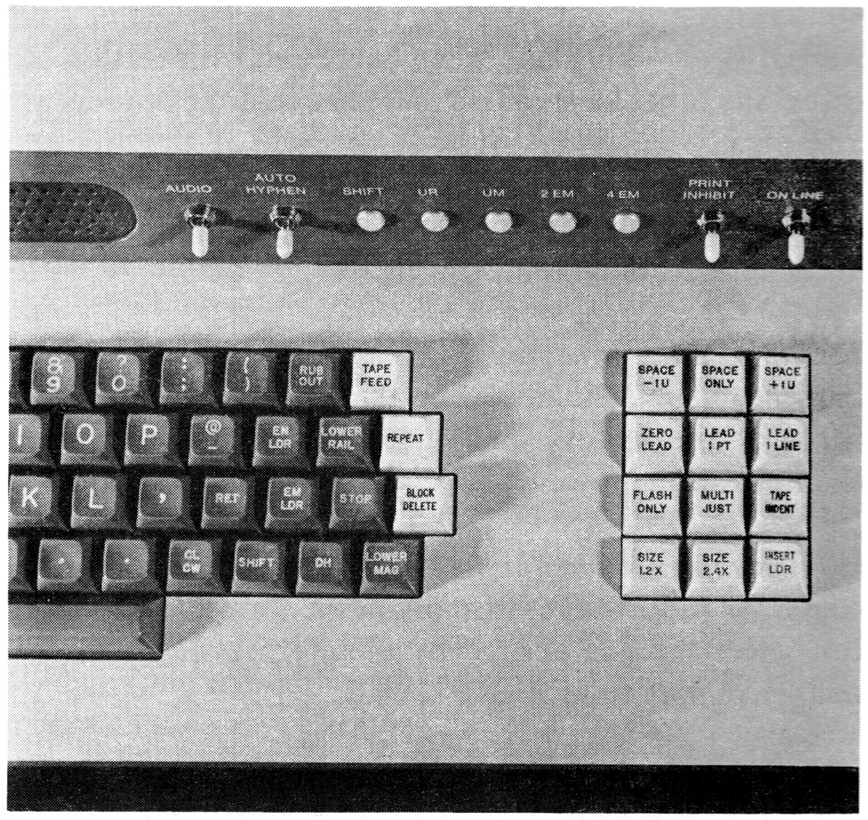
TAPE IDENTIFICATION CHART



*A BIT IS EITHER THE PRESENCE OR ABSENCE OF A HOLE

**A CODE MAY BE ONE OR MORE FRAMES

Datek of England manufactures an extremely extensive line of input keyboards and peripheral equipment. One peripheral that is of increasing interest is the line printer. This is the Datek version of a device to accept input tape and print out its contents for proofreading purposes.



Additional keys on the Dual Image keyboard permit single stroke command of all Compugraphic 4961TL typographic functions. Depression of one key often produces two printed codes.

A closeup of the key set of the Mergenthaler V-I-P keyboard. Note the extra rows of character keys. The indicator in the center displays line length for justification purposes. This is counting keyboard.

Back space — This feature allows the tape to be moved back one character at a time from the keyboard element. Most keyboard systems have some provision for reversing the tape, but not all do this by depressing a key.

Repeat key — This key, when depressed with certain other keys (or in some cases, any other key) causes that particular key to repeat until released.

Format storage — This is the ability to store, either on tape or electronically, a number of predetermined character sequences for changing line length, leading, font size, etc.

Multiple codes - one key — This is the ability to generate a 2 or 3 character sequence from a single key on the keyboard element. These are usually pre-wired at the factory and relate to some specific typesetter function, for example 'flash only'.

Widths mixed from the keyboard — Some keyboards can store different character width values (usually in the form of width plugs) and the operator can select the one desired by merely pressing a key. Width plugs usually relate to a particular font.

Code format — This refers to the number of channels or holes in punchepaper tape. Where an entry appears it means that the unit is available in either 6 level TTS code, 7 level Friden, or 8 level ASCII.

Hot zone indicator — The method used to tell the operator when the line end decision should be made.

Maximum line length picas — While true line measure varies with the counting technique used, most counting keyboards are classified by the maximum line length that can be counted, as measured in picas.

Type of display — In some cases, a typewriter; in others a moving display of the last 16 characters.

Number of characters — Refers to the number of different symbols that can be displayed to the operator, and has nothing to do with the number of characters in any given font set.

Notes on counting

To ensure that the finished typeset galley is well balanced and asthetically pleasing, it is necessary to use a system of differential character widths. In this way the larger characters, such as the W and M, occupy more horizontal space than the smaller characters, such as the I and J. Two methods are in use today.

Unit cut fonts

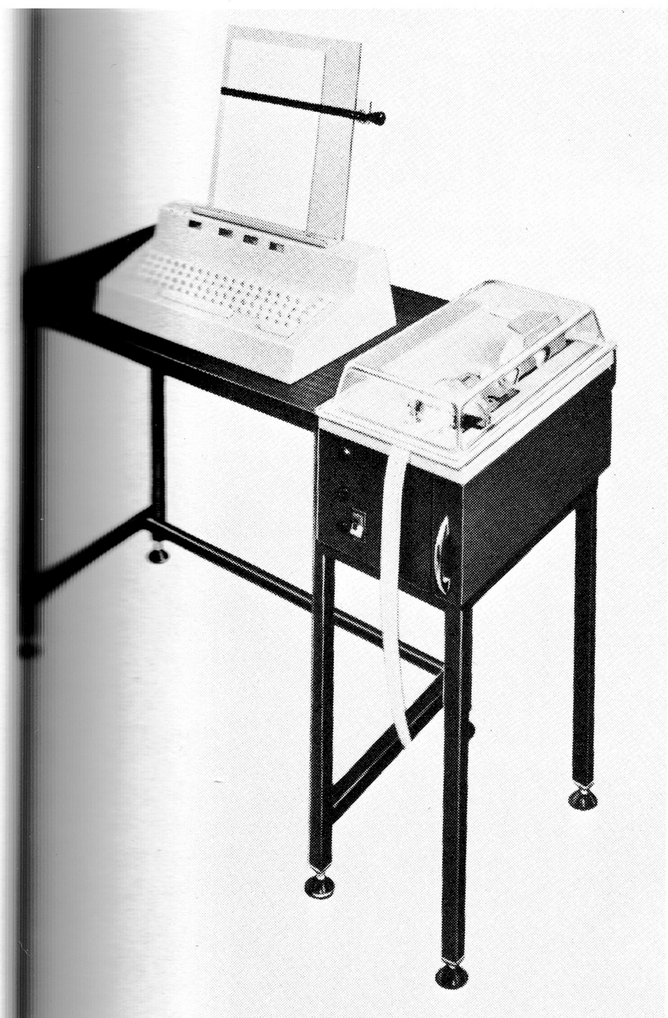
Sometimes called standard, or standard cut mats. In this system, the widest character in the font (the upper case 'M', also called the 'em quad') is divided into 18 equal parts, and multiples of the one eighteenth dimension become the width of the different characters in the font.

Non-unit cut fonts

Sometimes called multiface mats, this system is based on the division of the em quad into 32 units. Multiples of the one-thirty second dimension become the width of the different characters in the font. For example, the lower case 'i' may be 7 units (seven-thirty seconds of the em) with the upper case 'M' being a full 32 units. This ratio of character widths is true only for a given font size. That is, the 'i' may be 7 units in 12 point type, but only 5 units in a 16 point font. The multiface system allows greater precision in typesetting, since the width relationship of the characters varies with the point size of the font.

Blind, counting keyboards

Fairchild was the first company to offer keyboard systems to prepare the tape. The keyboards were designed to match a given linecaster, and were tailored to the kind of font being used, (unit cut, or multiface). Where the keyboard was used with a unit cut standard font, the keyboard was simply adjusted for the length of the line and the size of the type. Where the keboard was used with a multiface font, a 'width plug' was inserted to program the keyboard for the character width relationships, and the keyboard was adjusted for the length of the line to be set. Each font had an appropriate width plug. These machines were intended for the production environment and very little flexibility was built into them. With multiface fonts, it was necessary to manually change width plugs when changing font sizes.



One version of the Datek tape perforating keyboard (marketed in the United States by VGC). The keyboard is noiseless and the punch is covered. Operators were raising the cover in order to hear some indication that a key registered. Manufacturers have found that this "sound of accomplishment" is quite important.

Subsequent keyboards offered more flexibility, and multiface machines were now offered with the capability of having more than one width plug inserted at once. The Fairchild Universal 210 could hold two, and the Merganthaler Lino-Quick could hold 4. This permitted widths to be mixed from the keyboard, since the desired width plug could be selected by simply pressing a key. Blind keyboards offer no visibility of the data being keyed, although some operators are proficient at reading the holes in the tape. Most keyboards furnish indicator lights to display the status of the shift condition, upper or lower rail, etc. Line end decisions are made by the operator once the hot zone is reached. Most of these keyboards can be used in the non-counting mode.

Notes on hand copy

There are a number of different viewpoints on the subject of hard copy, and the opinions are varied and somewhat subjective. In essence, hard copy offers the keyboard operator visibility of the material being keyed. Most hard copy devices use a typewriter, which means that a typed page is prepared which corresponds to the information being recorded. Typewriters can display upper case, lower case, numbers and symbols. The typewriter character set is limited to the number of character positions available. The IBM Selectric machine furnishes 88 positions, while some of the type bar machines offer as many as 96. Since the printing is done by one mechanism, and the recording by another, it is impossible to guarantee that the information being typed is exactly the same as the information being recorded. Because of the character set limitations it is not feasible for a typewriter to display control codes, such as upper rail, quad left, etc.

Proponents of the hard copy machines feel that the primary advantage is accuracy. Since the operator can see every character, it is very easy to correct the most common keying problem, the single keystroke error. The hard copy machines are very useful for training new operators, and in addition, it is easier to compose complex copy (like display advertising) when the information is visible. The opponents of hard copy maintain that visibility of the data actually slows down the operator, and faster sustained keying rates are possible if the operator can not see what is being keyed. In addition, the necessity of returning the carriage breaks the operator rhythm and reduces keying rates. (In counting keyboards, where the operator must observe a hot zone indicator and make line end decisions, this argument is hard to support. It's extremely valid with non-counting keyboards).

The trade-off seems to be between higher production speeds (blind keyboards) and increased accuracy (hard copy systems). The final configuration is determined by the kind of task.

Hard copy, counting keyboards

These devices were originally offered to furnish more accurate keying of tapes to drive hot metal machines. However, the advent of phototypesetters began to change the keyboarding problem, due to the greater flexibility of the phototypesetting systems. It was now possible to set both straight matter and ad copy on phototypesetters, however the keying task to accomplish this became much more complex. For example, it required only a single keystroke (Upper Rail) to go from normal face to bold face, since the line length, leading, and character width criteria remained the same. However, to go from 8 point to 16 point type could take as many as 20 keystrokes in a precise sequence, because of the line measure implication. Thus, keyboards were offered to address the problems of doing in-line width mixing, and the changing of character fonts and-or line length. These keyboards contain subroutines that are adjustable to match a number of different typesetting or composing tasks.

The same counting procedures are used by these devices as with the blind counting keboards. Line end decisions are made by the operator once the hot zone is reached, and lights are used to display the status of the shift, upper or lower rails, etc. Most units can be used to produce non-counted tape.

Blind, non-counting keyboards

The advent of the typesetting computer created the market for these keyboards. The primary intention was for the keying of straight matter, where the operator made no line end decisions and speed was of primary importance. These keyboards permit the fastest posssible keying rate, and are limited only by the speed of the operator. While there is no visibility of the material being keyed, experienced operators seldom find this a problem, although new operators do. These are the simplest keyboard systems available, consequently they are the lowest priced. Some of these keyboards can be connected to slave typewriters to furnish hard copy, but this is not common in a production environment. Status lights are furnished to display the shift condition, upper or lower rails, etc.

A second type of blind non-counting keyboard was offered to prepare tapes for the more sophisticated phototypesetters. Rather than build format storage routines into the keyboards, the complex routines were stored in the computer used with the phototypesetter. In this way, four or five codes punched in the non-justified tape could cause the computer to insert the proper sequence of commands in the justified output tape. Keyboards with this feature usually have the function keys on a separate auxiliary keyboard and are sometimes referred to as 'computer' keyboards.

Hard copy, non-counting keyboards

These keyboards are generally counting keyboards with the counting mechanisms removed, or else typewriter systems that were originally intended for other reasons and are now being offered to the Graphic Arts Industry. They cost more than blind devices, and do not permit the same high keying speeds due to the necessity of periodically returning the carriage which breaks the operator ryhthm. Their primary application is the more accurate keying of straight matter, or the training of new keyboard operators.

Once the material has been typeset and reviewed by the proof reader and the appropriate areas of the action identified, the information is passed on to the place where the material is corrected.

Irrespective of the nature of the error, it will always be corrected by one of two actions: (a) something must be inserted, and-or (b) something must be removed. With these two correction steps in mind, we now need to address the reason for the change.

This involves the correction of keystroke errors, or spelling mistakes. To implement the correction, it is necessary to have access only to that portion of the material in question. There is no need to be able to review either preceding or subsequent material. Further, the material can be corrected by the substitution of very small amounts of new data; usually the insertion of a correct letter or correct word is all that is required.

This involves the complete overview of all the material, or at least the overview of some complete segment of it. Editing may require entire paragraphs removed, replaced, or relocated elesewhere in the sequence. To implement revisions, it is necessary to have access to large amounts of material, and the amounts of new data may be considerable.

This applies to such problems as updating telephone directories, personnel rosters, guidebooks, etc. The material in question is typically handled in a unit (e.g. name and address, name and department number-telephone, etc.) and whole units of information are removed or inserted. Access to large amounts of the material is not required, since the information is usually arranged in sequence (alphabetic or numeric) and the insertions or deletions can be structured the same way.

The factors that influence corrections are: amount of material to which access is necessary, size of insertions-deletions (number of characters or

words), method used to insert material, time permitted to complete alternation.

The process of correcting, editing, and-or updating material is inherent in any typesetting operation. It is useful to understand the traditional procedures before examing some of the newer devices being offered. Since proof reading is virtually the same in all cases, our primary focus will be on the manner in which corrections and-or alterations are handled.

Manual Methods

Proofreading is done from the galley. The galley may be the output paper from a phototypesetter, or it may be a reprocopy pulled from the chase containing the cast lead slugs. After proof reading, the fix can be accomplished in two ways:

Hot Metal

The correct information is keyed, and new slugs or lines are cast. These slugs are inserted in the chase in place of the incorrect or non-valid lines. The minimum amount of material that can be replaced is one full line.

Phototypesetters

The correct information is keyed, and the tape run through the phototypesetting machine. The output paper is then pasted over the incorrect or non-valid portions of the original galley. In practice, all the corrections are keyed and processed at the same time, so the output paper may contain a number of corrections.

If the correction involves the insertion of some information previously omitted, it may be necessary to rekey entire paragraphs of correct information because of the 'domino effect' of the insertion.

With either method, it is impossible to proof read until after the typesetting function. In the event of a number of errors, the usual procedure is to re-key all the information and discard the first pass. The lack of visibility of the data prior to typesetting often results in a significant amount of waste, in terms of people time, machine time, and supplies cost.

Automated Methods

A number of systems are available today, offered in different configurations and with varying degrees of flexibility. Basically these machines offer the same principal thing; the facility to display and massage the material prior to typesetting. The methods used to display and the flexibility of the alteration procedure are the primary considerations when evaluating the use of these systems. Some machines permit proof reading and correction to be done at the same time, other systems are structured so that correction takes place on a second pass. Some systems can address several different types of alterations.

It is very difficult to make meaningful comparisons of different types of systems, due to the varying capabilities of the hardware and the extremely broad range of correction - editing - updating problems. Rather than make comparisons, it seems more reasonable to illustrate the principle of a given system as applied to a given alteration task. The best system for a given application depends on the application and the economics governing it.

Keyboard methodology

The earliest tape perforating keyboards were completely mechanical. On a mechanical keyboard the keys are linked to the tape punch by a series of levers. Under each key, and running from the front to the rear of the machine are coding bars which are serrated in accordance with the code to be punched, and these operate a series of combination bars which run at right angles to them. There is a combination bar for each code channel, and they interpose a system underneath the punch knives. When a key is depressed, the required code is set on he interposes under the punch knives and at the same time a clutch is operated which causes a continuously running electric motor to operate a cam under the punch knives. This cam forces the knives through the paper tape in those channels where the interposes have been set on the code bar.

There is necessarily a ball-lock device on the mechanical keyboard to prevent two keys from being depressed simultaneously. This can also be adjusted to operate early or late on the keystroke. With the continuously running motor, the mechanical movements make the keyboard noisy in operation. Because of the type of construction involved, the slope of the key panel of this type of keyboard is usually much greater than the 12 or 15 degrees which has been found to be optimum on modern high-speed typing devices. Also, the space between keys is generally 7/8", as against the 3/4" spacing of typewriters. Because of the mechanical design it is impossible to change the layout of the keyboard or to add additional keys, so that these machines are very inflexible.

In an effort to overcome the problems of slow and heavy operation of the completely mechanical keyboard, ***electromechanical keyboards*** were introduced. These keyboards still operate coding bars from the keys, but the combination bars of the mechanical keyboard are eliminated. The operation of a key allows the code bar to slide forward and operate on a series of contacts. These contacts are wired to the code magnets of the punch which set up interposers under the punch knives. The key also operates a clutch which allows the continuously running electric motor to turn a cam and force the punch knives through the paper. The mechanical interlock has been taken off the actual key and operates on a sliding code bar on some types of these machines so that only one bar is allowed to make contact at one time.

The third type of machine is the *contact* type. It employs a simple electrical contact or switch which, when the key lever is depressed, brings two pieces of electrically conductive material into contact, allowing a current to pass. For the contact to break when a key is released, it is usual for a contact to be mounted on very spring-responsive material. Because of this, whenever a contact is made by depressing the key, 'contact-balance' occurs. That is, the

two contacts make and break contact rapidly. This causes two problems: first, balancing-contacts can allow a code to pass after the key has been released, and this can lead to a corrupted code being punched when the following key is operated quickly. Second, whenever a current is broken by means of a contact or switch, arcing takes place. To a lesser extent, arcing also occurs when the contact is made. In time, the arcing builds up a high-resistance deposit on the contacts and thus reduces the current flying through the contacts.

To overcome the known problems of switching current, a *photo-electric keyboard* was produced by the Invac Corporation. This type of keyboard consists of a number of light channels with a photo diode at one end and a light source at the other. There is a light channel for each bit of the code plus a control channel, and they run parallel to the back of the machine. Over the light channels and at right angles to them are a series of code bars which are operated when a key is depressed. These code bars are designed in such a way that a shutter drops into the light channel when the key is operated, thus preventing the light from reaching the photo diode at the other end. The number and position of the shutters on the code bar determine the code to be punched by that key, since the photo diode only passes current when it is illuminated. The count is used to actuate the punch knife in that particular bottom of its stroke, the shutter would not reach the bottom of the light channel. This would allow light to pass through and cause a wrongly punched code. To meet this intrinsic problem in the photo-electric keyboards, the keys are power-assisted so that when a key is depressed a solenoid or electromagnet is operated, it pulls down a key plus its code bar, thus insuring that the shutters reach the bottom of the light channel. Unfortunately the force with which the shutters hit the bottom of the light channels causes them to vibrate, thus allowing spurious light onto the photo diode. This spurious light can, of course, cause mispunching when the keyboard is operated quickly.

In an effort to overcome this, a very heavy mechanical interlock had to be introduced, and its slows the keyboard down considerably. Consequently, it can be seen that 'contact-balance' has been replaced by 'shutter-flutter' with the same damaging results. Another cause of trouble on the photo-electric keyboards is the gradual reduction in the strength of the light source on the output from the photo diodes. This can eventually lead to mispunching. As with mechanical and electro-mechanical machines, there is no flexibility of keyboard layout, and if additional keys are required, they have to be built into a supplementary keyboard.

Finally, there is the reed switch type of keyboard. It incorporates keys consisting of a relay operated by a magnet. When the key is depressed, the magnet is moved down the reed and causes the contacts of the reed relay to close and so allow current to pass. When the original keyboard of this type was introduced some years ago in Europe it was thought that here at last might be the answer to the problems on mechanical, electro-mechanical, contact and photo-electric keyboards. However, the initial installation was a failure because the operators complained emphatically about the feel of the keyboard. An operator likes to know that when he or she presses a key that it *has* operated effectively, and this can only be verified by a feel that *something has happened* at some some point in depressing the key. On a reed

switch, it is rather like operating a piece of sponge. You press the key down against a spring and there is no point in the key stroke at which the operator can tell that the key has, in fact, operated. As a result, it was held necessary in at least one later installation to cause an electronic squeak to sound each time a key was depressed. The operator then knew the key had operated.

The Future, What?

Significant changes in keyboards have been made in the past four years. Share-of-the-market ratios have changed dramatically. The over-all picture of the keyboard industry is not unlike the conditions that prevailed during the surge of developments in photocomposing machines a few years ago.

Improvements in keyboards include such familiar features as electronic key-mechanisms, memory units capable of holding multiple-key commands in storage, ready to be called out with a single keystroke, indicators for various machine functions and visual displays of the last character or characters punched.

The most obvious changes have to do with the stroke of the keys and the size of the keyboards themselves. Electronic components and solid-state circuitry, have reduced keyboards from huge, clanking monsters to sleek, silent office machines. The mechanical operating units with their stiff key actions have been replaced with light touch actuating units found in office typewriters.

Despite the changes in the keyboards themselves and the introduction of operating OCR and VDT units into newspaper production, keyboarding remains a major bottleneck. At some point in the production cycle, keyboarding must take place. Whether it comes at the front end, in the editorial department, or at the photocomposing machine itself, keyboarding remains a manual operation and can limit the full potential of any composition system.

There are several possible solutions to the keyboarding problems, but most of the experts agree that the act of keyboarding will never be entirely eliminated.

The ANPA Laboratory Committee's subcommittee on keyboards has recently issued an interim report incorporating some suggestions aimed at improving keyboard design. The concensus of the subcommittee members favored secretary shift over perforator shift because it required fewer keystrokes.

The committee apparently sidestepped the problem of hard copy or visual indicators, stating that hard copy was most desirable but not justified economically. Their report mentioned the possibility that hard copy or visual indicators might act as a distraction, although no conclusive studies are available regarding this point.

The question of key standards was also dismissed with the observation that factors of key spacing, stroke length, contour, pressure or tactile feedback are not critical if kept within "reasonable" limits. The committee did

recommend incorporation of 14-inch tape rolls and automatic tape rewinders as time and money savers.

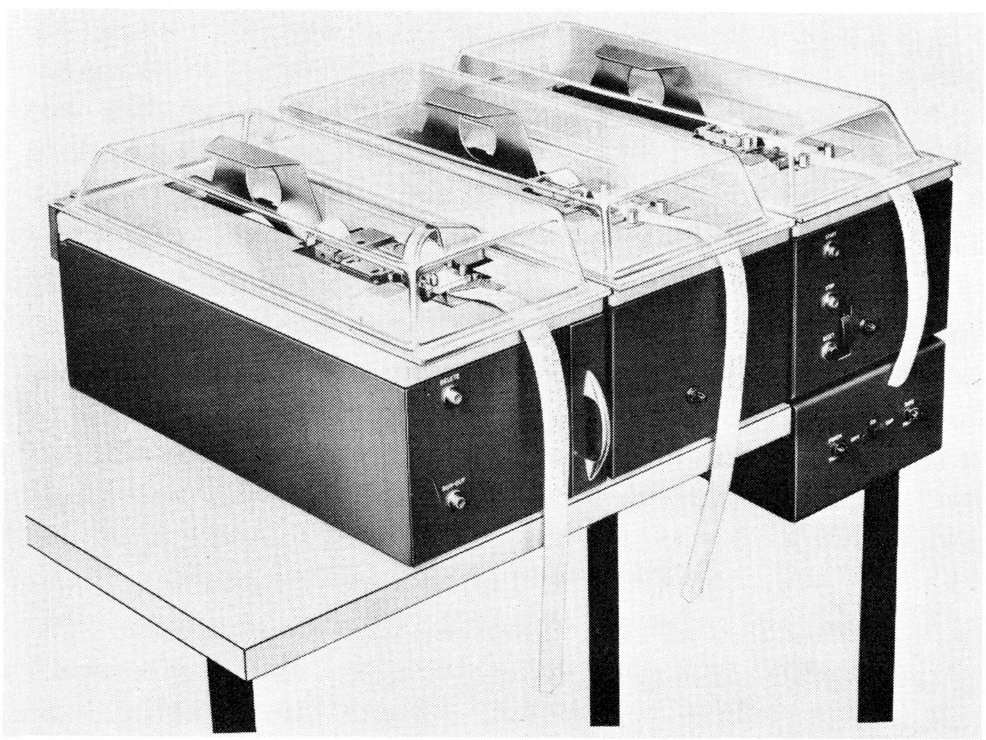
Tape backup under keyboard control and the ability to delete a whole word were deemed desirable features. The issue of key alignment, either off-set or vertical, was deferred on the basis that there are no conclusive studies indicating a preference for either arrangement.

Revisions in the keyboard layout and the use of special keys to produce a preselected code series under single key command offer significant opportunities for increased efficiency. The ANPA committee was intrigued with the possibility of separating the two halves of the keyboard and using the space for special function keys. But they viewed the possibility of too many command keys as a possible detriment, observing that operator output might be slowed if too many keys were used and search time increased.

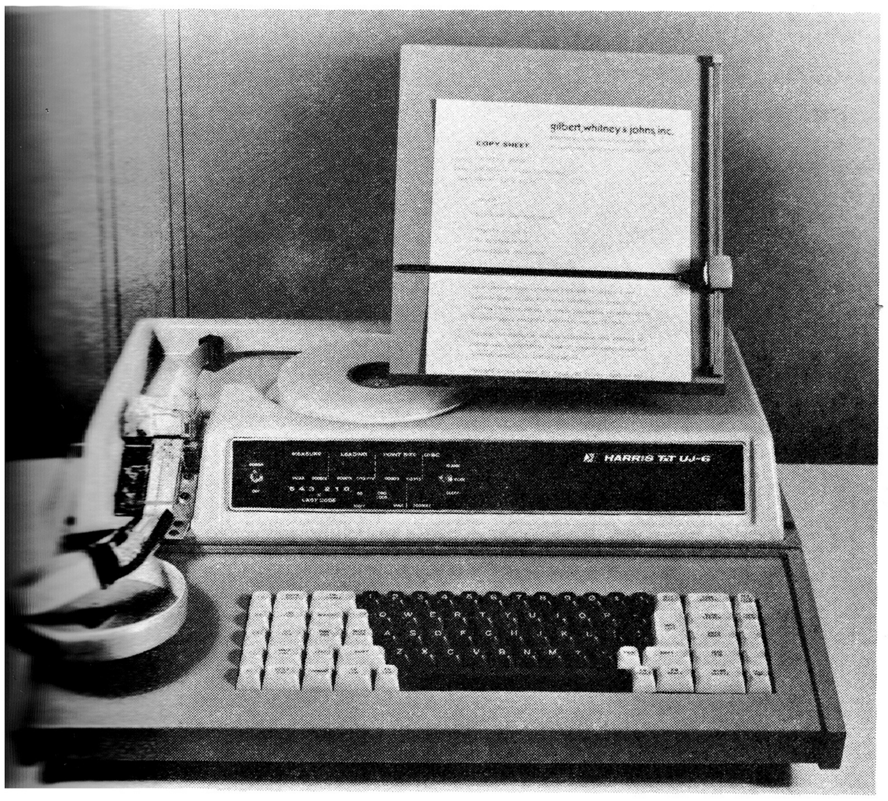
Keyboard layout has a long and unfortunate history. Legend has it that the inventor of the so-called "universal" keyboard, Christopher Latham Sholes, had problems with sticking type-bars. To solve the problem, he moved frequently used letters as far apart in the type basket as possible. The unhappy arrangement of keys, dictated by long-supplanted mechanical considerations, continues to add to the bottleneck.

Remember Etaoin Shrdlu? He wrote many a popular column, only to have his name blue-penciled by stuffy editors during the hot metal years. Etaoin Shrdlu, of course is none other than a personification of the letter frequency table used in laying out a linotype keyboard. And many an operator, clearing his machine, stroked those two immortal words. Compared with the illustration of the universal keyboard and it becomes obvious that this layout has some definite shortcomings.

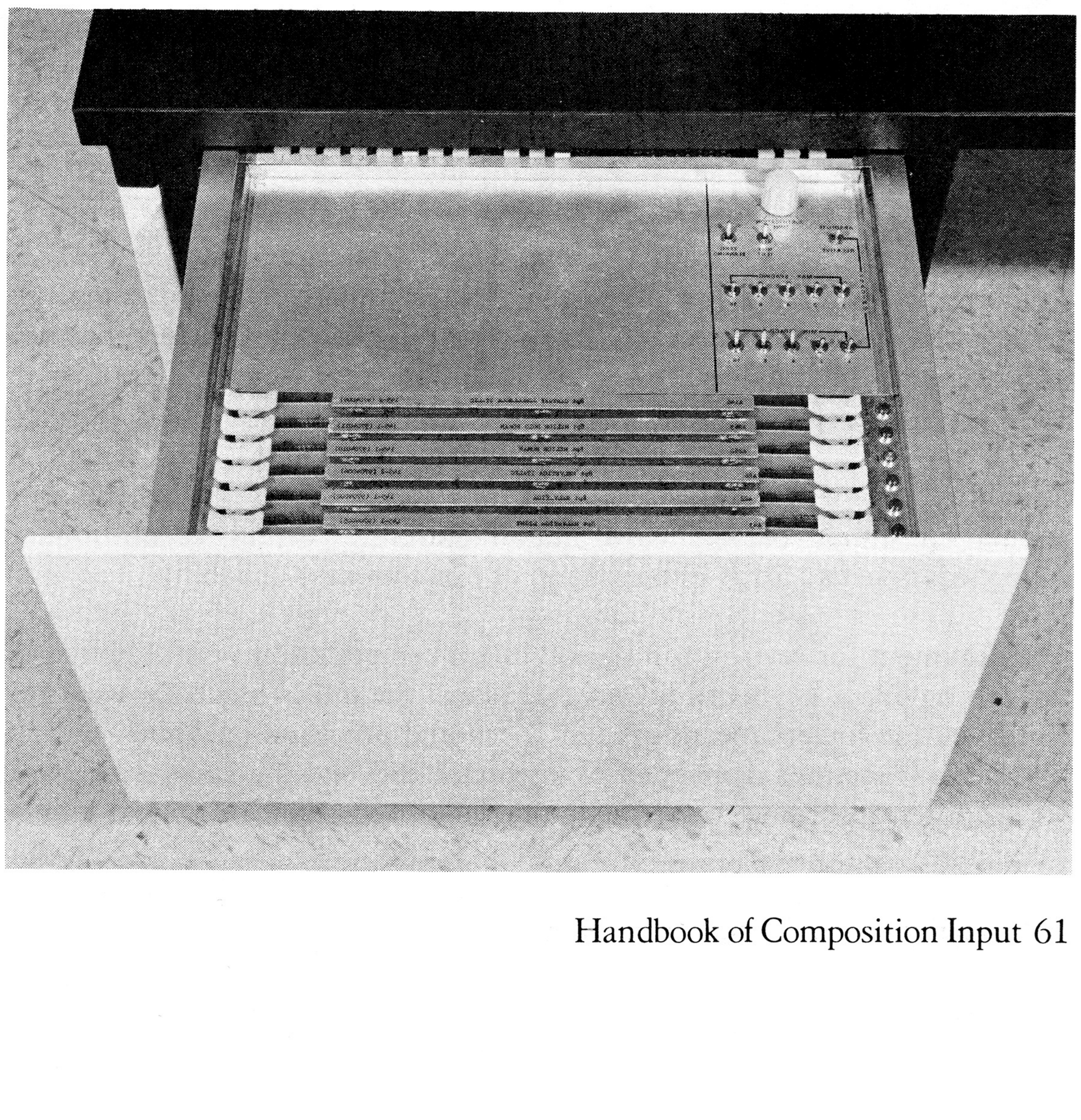
The universal layout has additional shortcomings in the uneven load placed on the different fingers. The so-called Hoke arrangement provides a more evenly distributed work load over both hands and provides for shift key control by the stronger and more mobile first fingers.



In a pure tape environment it often becomes necessary to incorporate changes from one tape into another. There are few tape mergers on the market (above is the Datek version with two readers and a punch) possibly because many users with computers already have a means of merging tapes.



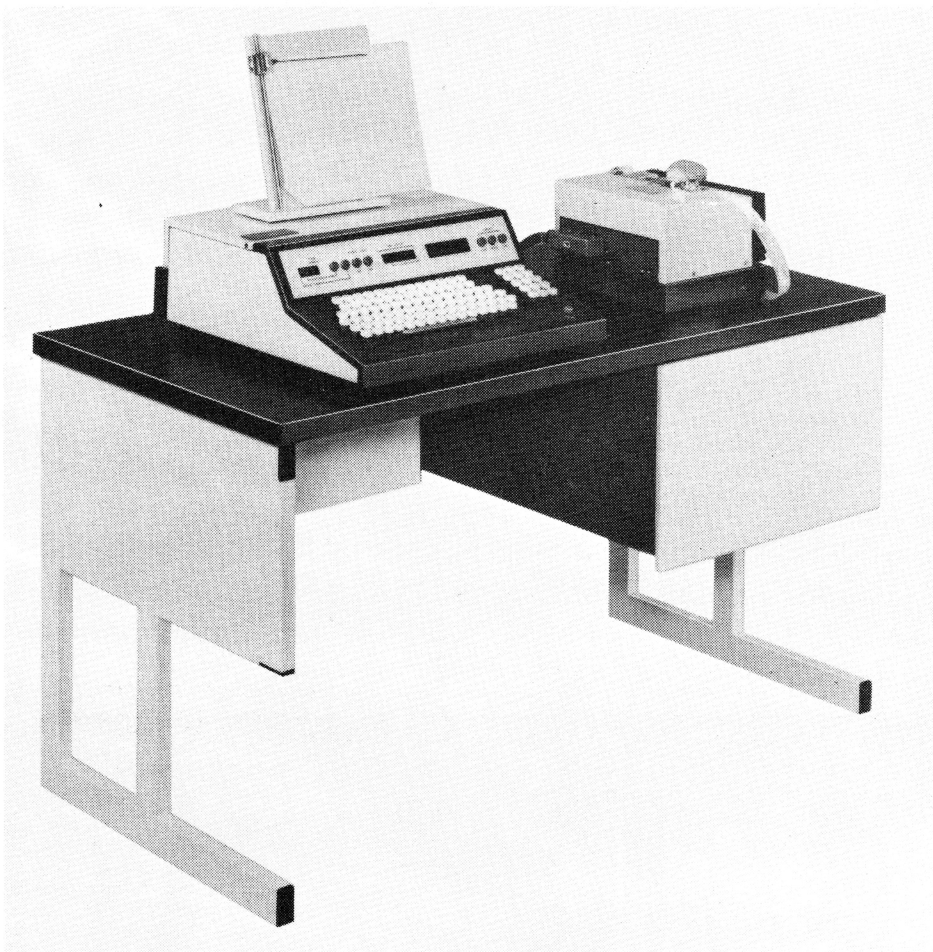
Two new keyboards are shown here from Intertype. Both are dedicated units designed for optimum operation with the Fototronic TxT (above) and the Fototronic 600 (below). There is a "soft copy" visual display and ample indicators to tell the operator the status of the unit at any point.



In order to mix fonts at a keyboard, it is necessary to store the associated character width values of all fonts. Here is a view of the width boards used in the V-I-P keyboard.

The possibility of a split keyboard is of general interest. One such keyboard, developed by Dr. Kroemer of the Max Planck Institute in Germany, has the two sections angled to fit the natural resting position of the human hand. The key rows are curved to match the corresponding spread of the operator's fingers. A curved space bar enables the operator to strike it from any location on the keyboard.

Operator speed is one area presently under attack. No fewer than three companies presently have programs for keyboard training to improve operator performance. Carefully designed training programs have enabled operators netting 6,000 to 10,000 keystrokes per hour (kph) to attain and maintain speeds of 20,000 to 24,000 kph together with significant error reduction.



An overview of the Mergenthaler V-I-P keyboard. Note that the punch is in a separate unit.

Training programs aim at improving the techniques of keyboarding, and helping the operator "get out of his own way." Emphasis on reading speed improvement, physical exercises, attitude and approach all figure in the various training programs.

Simplification of the keyboard operation seems to be one of the more popular pastimes of keyboard manufacturers. Current generations of keyboards boast an array of command or function keys capability.

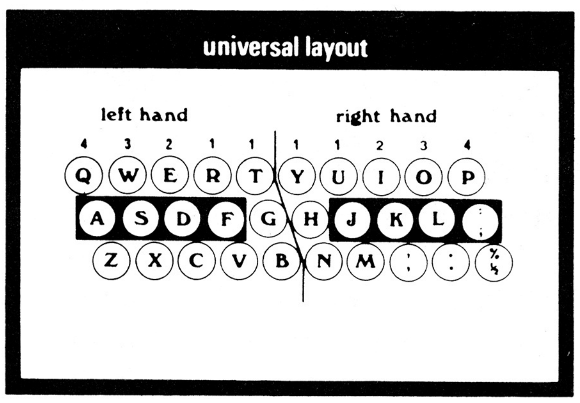
The argument for revisions in the keyboard centers on two issues. First, the logic of having a keyboard layout that places the most frequently used keys closest to the fingers means greater speed and precision in typing. Second, the special functions demanded of keyboards beyond the normal keying of words differ according to the computer, phototypesetter or optical scanner being used.

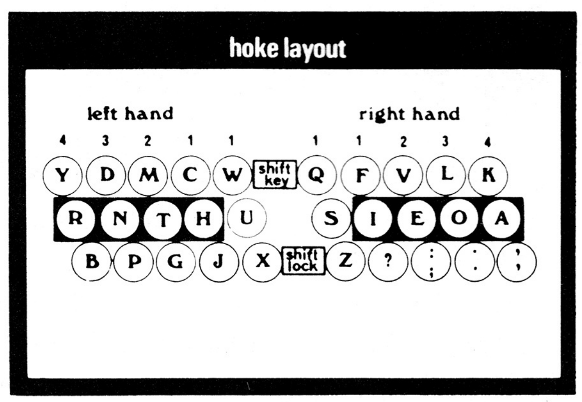
The keyboard in common use today is termed the "universal" layout. Invented over 100 years ago, the universal arrangement has only one-third of the total keystroking on the "home row." More work is allocated to the left hand than to the right.

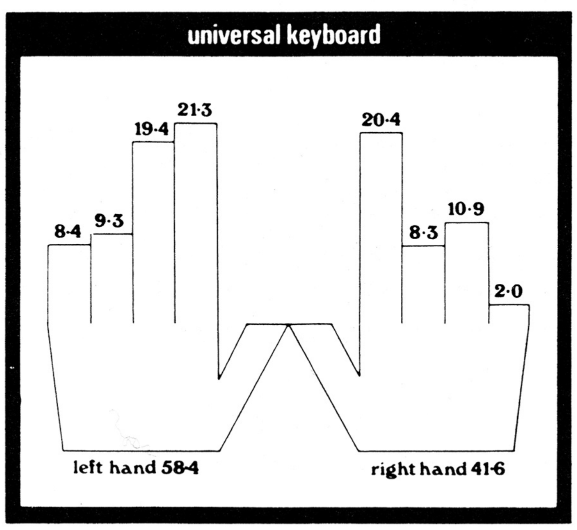
The more logical layout would put a greater number of frequently used keys in the home row. Since the right hand is generally more flexible and stronger than the left, a greater percent of the stroking would be allocated to the right hand. Likewise, because the first two fingers are more dextrous, reaching above and below the home row would be easier with the first and second.

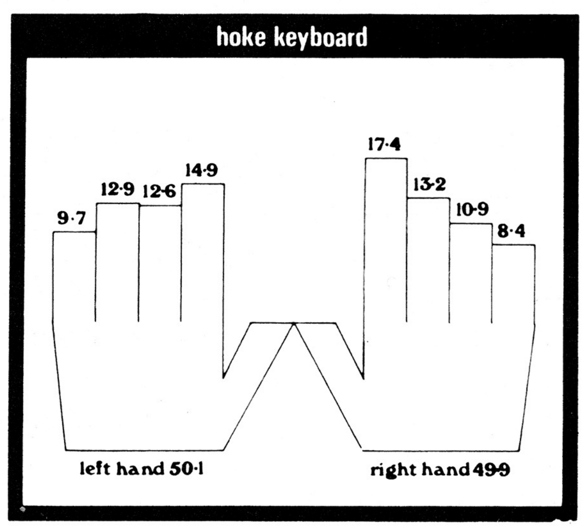
Another factor holding up production speed on the universal layout is the poor "chording" availability of the arrangment. Many letters fall together in groups of two or three. If these letters were placed according to the frequency of their use and under alternate hands, it would be possible to hit successive letters much faster than using one hand. Examples of difficult chording situations include the prefix "re" and the suffix "ion." Both are presently one-handed operations and, therefore, slower than if they could be keyed by two hands in the manner of striking rolling chords on a piano.

Compare the Universal and Hoke keyboards. The home row keys in the Hoke version contains more of the most frequently used letters. The workload is evenly distributed between both hands, aiding speed and reducing fatigue. The major difference, however, is in the placement of the shift and lock keys in the middle of the board. The index fingers in the human hand are more flexible and better suited for reaching than are the fourth fingers. Since control functions are frequent and are actually interruptions in the flow of coding words, the positioning of shift keys in the center of the keyboard would tend to reduce those interruptions.

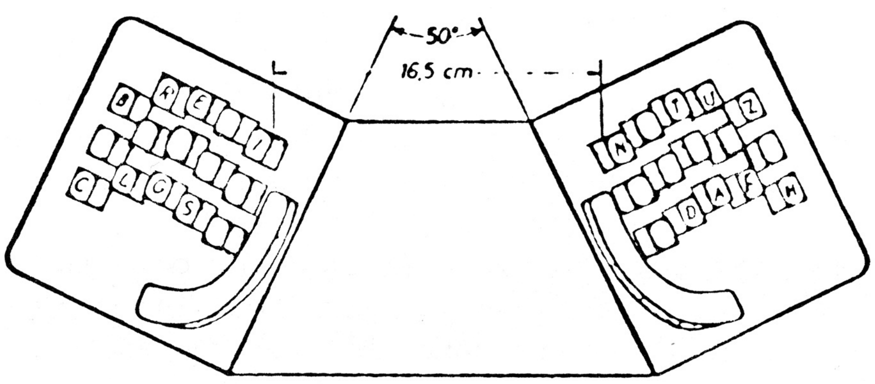








Operation	Keystrokes per Hour	Ems Approx. per Hour	-Equiv. Typewritten Words/Min.
1. Manual Linecaster	7,000	3,500	23
2. Monotype Keyboard	10,000	5,000	32
3. TeleTypesetter Keyboard (Justified Lines)	10,400	5,200	33
4. Typewriter Keyboard (Non-justified Tape)	18,000	9,000	59
5. Typewriter	23,800	11,900	78



The so-called Kroemer keyboard, devised by Dr. G. E. Kroemer of the Max-Planck Institute for Work Physiology, features a split and sloping board. The designed takes into account the natural angle of wrist flex of the human hand doing work, one major source in keyboarding fatique. The shift bars are also designed to permit striking from anywhere on the keyboard. The center areas between the two keyboard halfs would be used for command keys presently operated by the slower and less flexible fourth fingers. (Inst. of Prnt.,London, 1967)

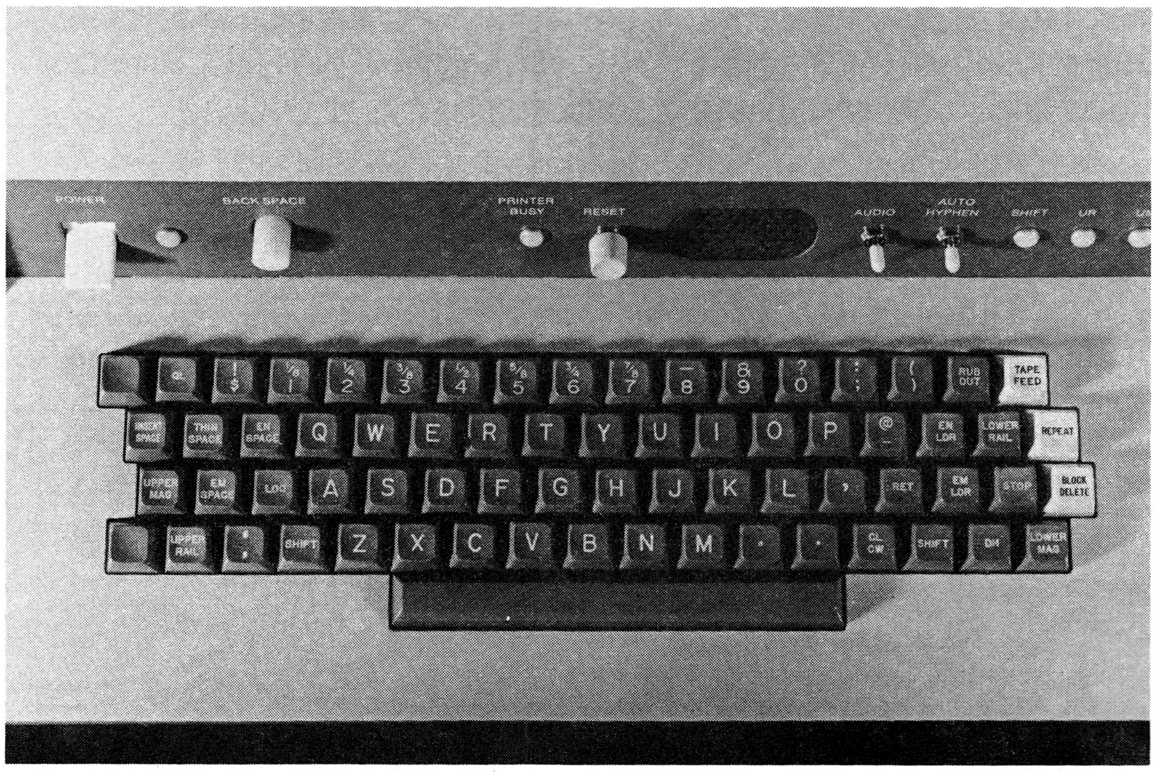
One frequently asked question is that of expected keyboading speeds. This is one of the reasons for the creation of the National Composition Association Production Measurement Committee which is finalizing its report on keyboard production standards. It will be interesting to compare some of the conclusions of the Production Measurement activities against your own findings. While these standards are not based on a controlled study and do not indicate the specific type of equipment used, they do offer some interesting information.

It is obvious that a manual linecaster offers some mechanical limitations which affect the productivity of the equipment. The Monotype and TeleTypesetter keyboards also offer some mechanical limitations along with end-of-line decisions which can hamper total productivity. In these standards, the only apparent difference between typewriter keyboard (non-justified tape) and straight typewriter is the typing skill of the operator. This confirms some of the preliminary conclusions drawn from the NCA study. In fact, we have suggested that all operators be given a typing test in order to ascertain their production potential. A copy of the typing test is available from NCA/PIA headquarters.

Dual Image Keyboard

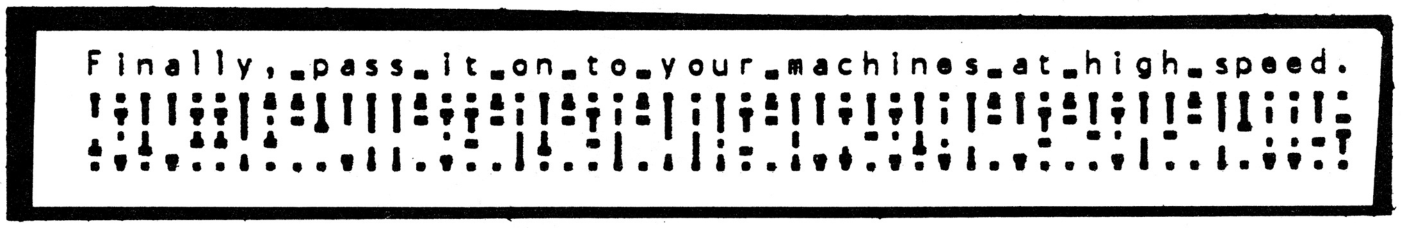
Dual Image keyboard devices must be considered in a separate category, due to the difficulty in comparing them to any traditional keyboards. Dual Image offers the speed advantages of blind noncounting keyboards, combined with all the visibility benefits of hard copy machines.

The system utilizes electronic keyboard elements which are solid state devices. With the exception of the key shaft itself, they have no moving parts. A two character memory is provided so that burst keying does not result in any lost or erroneous characters, and this is coupled with a recording mechanism that can accept data at speeds up to 30 characters per second. The keyboard, the memory, and the recorder combine to form a keyboard system that can operate at keying rates in excess of 100,000 keystrokes per hour.

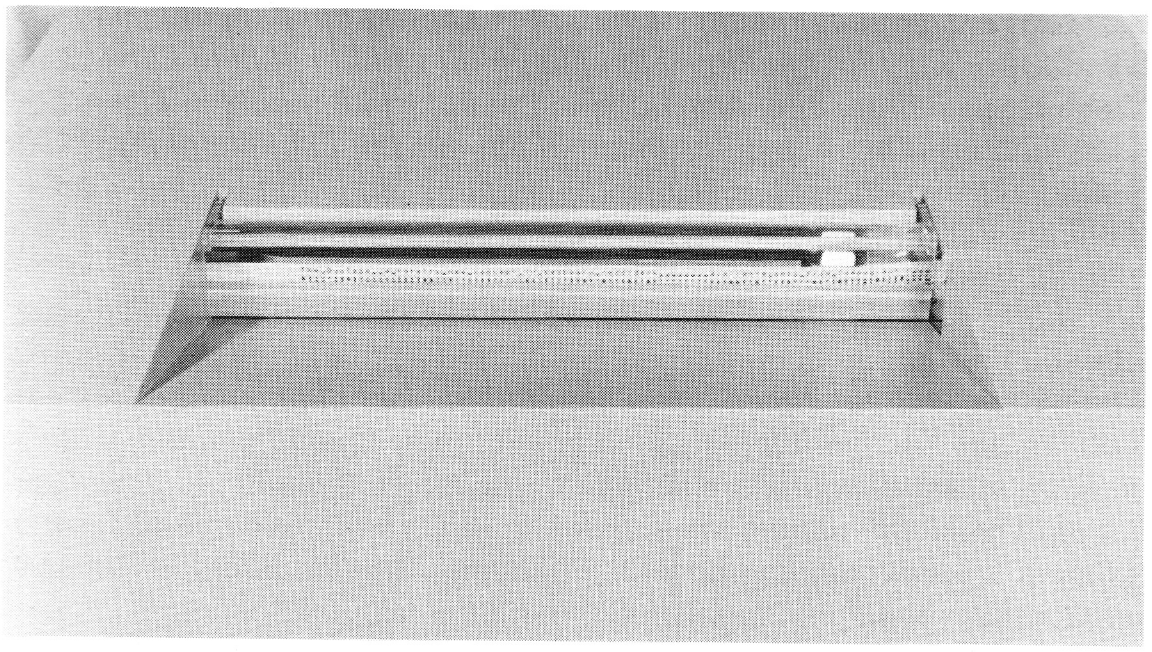


The main keyboard of the Dual Image Recorder.

The use of printed paper tape gives all the benefits of hard copy, yet does not introduce any of the disadvantages of typewriters. All other hard copy keyboard systems depend upon the use of a typewriter for visibility,which has two major disadvantages: 1) limited character set, 2) need for carriage return, which breaks keying rhythm and reduces effective keying speeds.



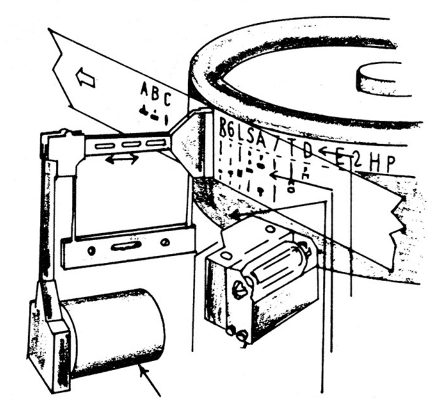
Dual Image tape.



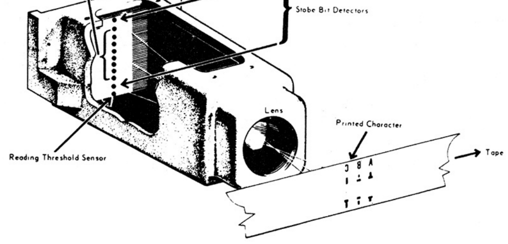
Characters and functions are immediately visible when keyed on the Dual Image keyboard. Dual Image is an interesting approach to the hard copy concept.

Dual Image is not affected by either drawbacks, since the machine can display a full set of 128 different symbols. The printing is on a continuous strip of tape, so the operator never needs to break keying rhythm.

It can display both upper and lower case textual material, just like a typewriter. In addition, the expanded character set permits control codes to also be printed, and these control codes describe the function so that the operator needs to make no 'meaning' translation. For example, Quad Left is QL, Upper Rail is UR, Lower Magazine is LM. Other hard copy machines, using typewriters, frequently print nothing for the command codes. Sometimes a command code is a textual character printed in red.



The Dual Image recorder.



A Dual Image optical reader.

The heart of the Dual Image system is the high speed impact printer. The tape to be printed is positioned between a hammer and a high speed print wheel (which rotates at 1800 rpm). When the desired character is in position, the hammer strikes, printing both the human readable symbol and the machine readable code at once. There can never be any disagreement between what the human reads and what the machine reads. The last character printed is immediately visible to the operator, so that material being keyed can be immediately reviewed and confirmed. The recorder operates with a minimum of moving parts, ensuring a long life and trouble free operation.

Once the tape is prepared, it can be easily read into a computer or phototypesetter by using a Dual Image reader. This is a solid state photo-optical scanner, and can read information at rates up to 300 characters per second. As the tape is moved past the lens, the bit pattern is focused on a plane of photo-transistors, and the character is electronically read. The reader can be made to emulate a variety of traditional devices, such as the Teletype CX 100 reader, the Tally 424, or Digitronics readers.

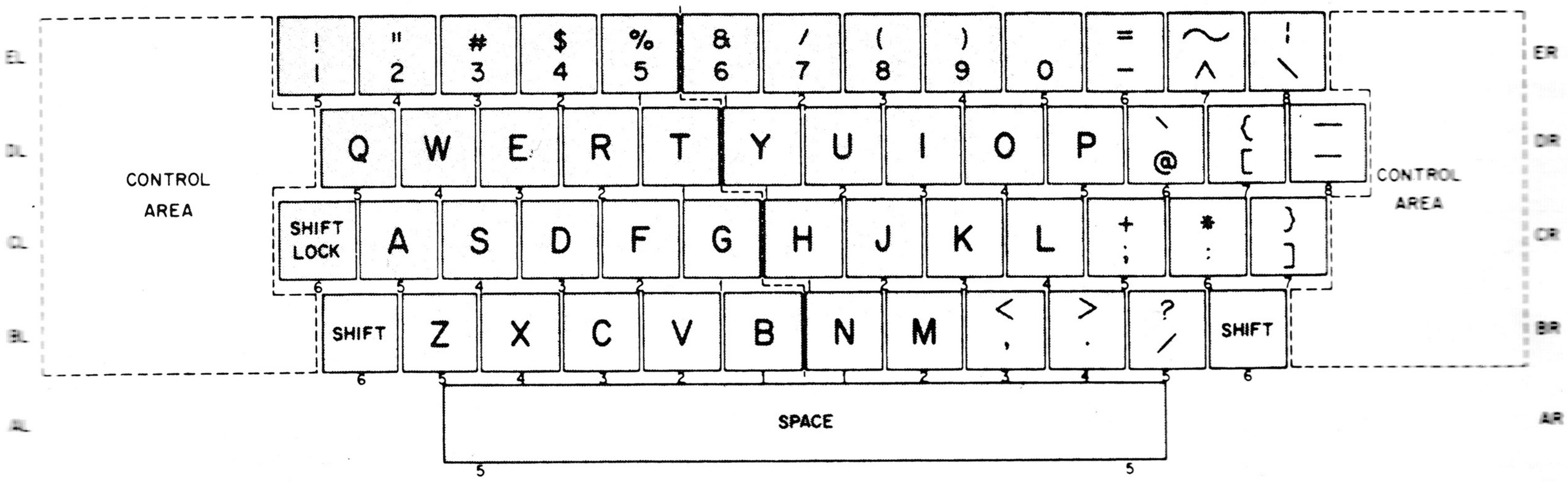
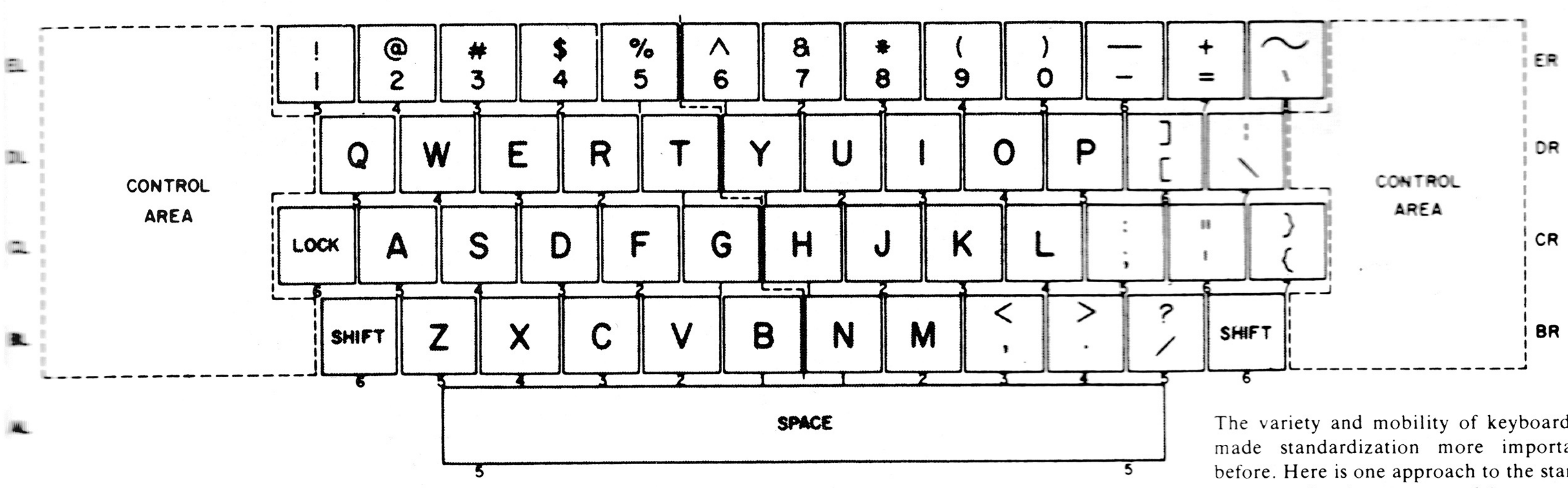


Fig. 1 Proposed U.S.A. Standard: Logical Bit Pairing



The variety and mobility of keyboard operators has made standardization more important than ever before. Here is one approach to the standardization of the typewriter key set as used for computer input. The program was sponsored by the American National Standards Institute (ANSI) and the Business Equipment Manufacturers Association (BEMA).

How to tailor a keyboard. Here are three companies that make the job fairly simple. Number One is Invac which provides a layout grid for indication of keytops and codes. Number Two is the Connecticut Technical work sheets. And Number Three is the layout grid for Keymatic Data Systems (whose magnetic tape encoder can access all 256 possible EBCIDIC codes recognized by a computer). In all cases, the user can design the arrangement to meet his specific needs.

Combination Chart Used for All INVAC Keyboard Formats

INVAC Corporation provides three basic keyboard formats:

(1) PK-244 (48 keys)
(2) PK-264 (64 keys)
(3) PK-275 (75 keys)

Three shades of gray indicate the limits of each keyboard format (see Legend below). Note that the PK-275 extends across all three shaded areas, the PK-264 uses the two lighter shades, while only the central, lighter area comprises the PK-244.

Each key position is connected by a line to a row of code and key color specification spaces in the lower section of the chart. Please note that individual "key-numbers" identify both the key position and the related code and key color data.

Please refer to the notes on this page and the "Check List" on Page 1.

A sample chart on Page 4 shows a typical customer specification.

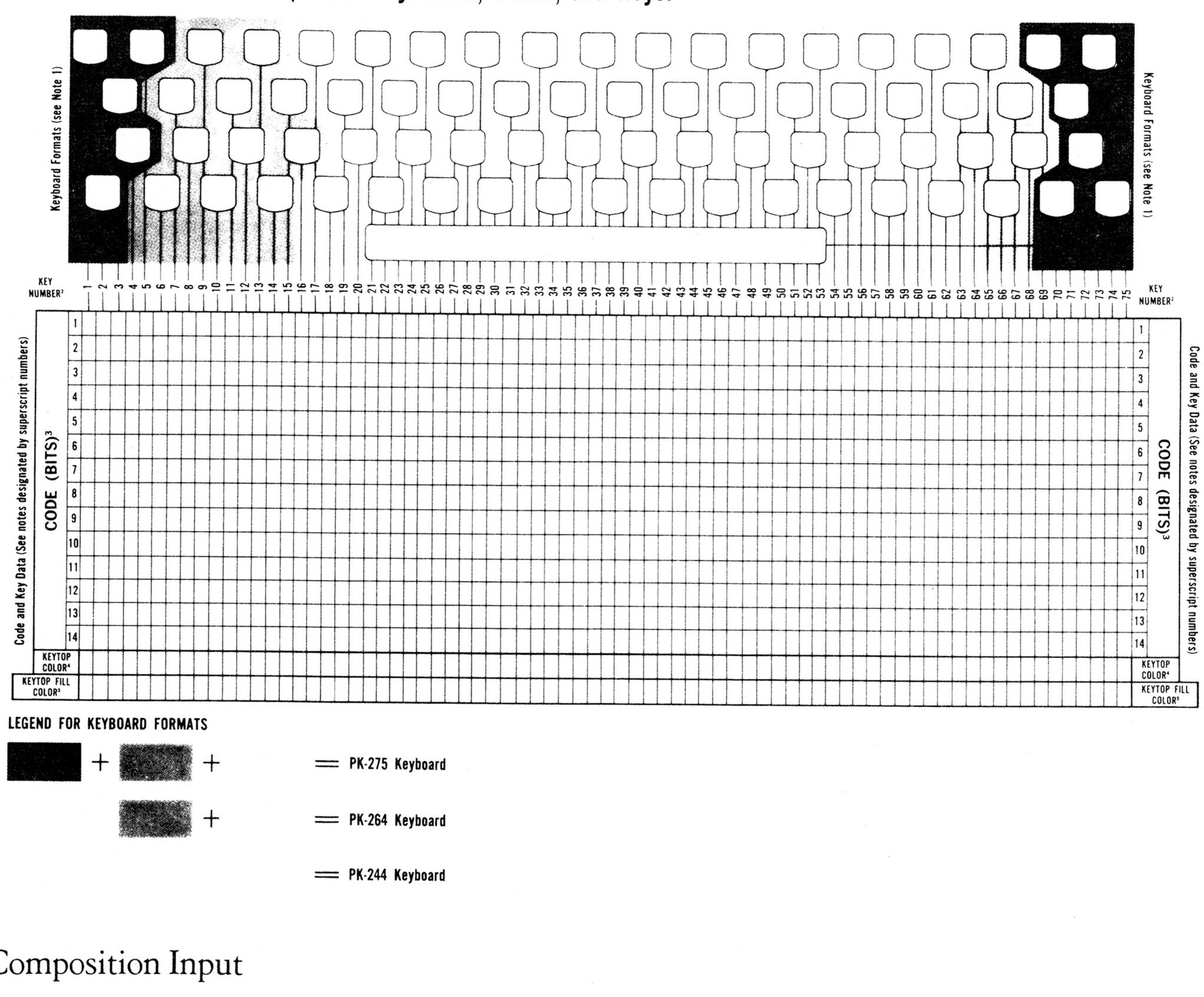
Other Information Needed to Complete the Specification

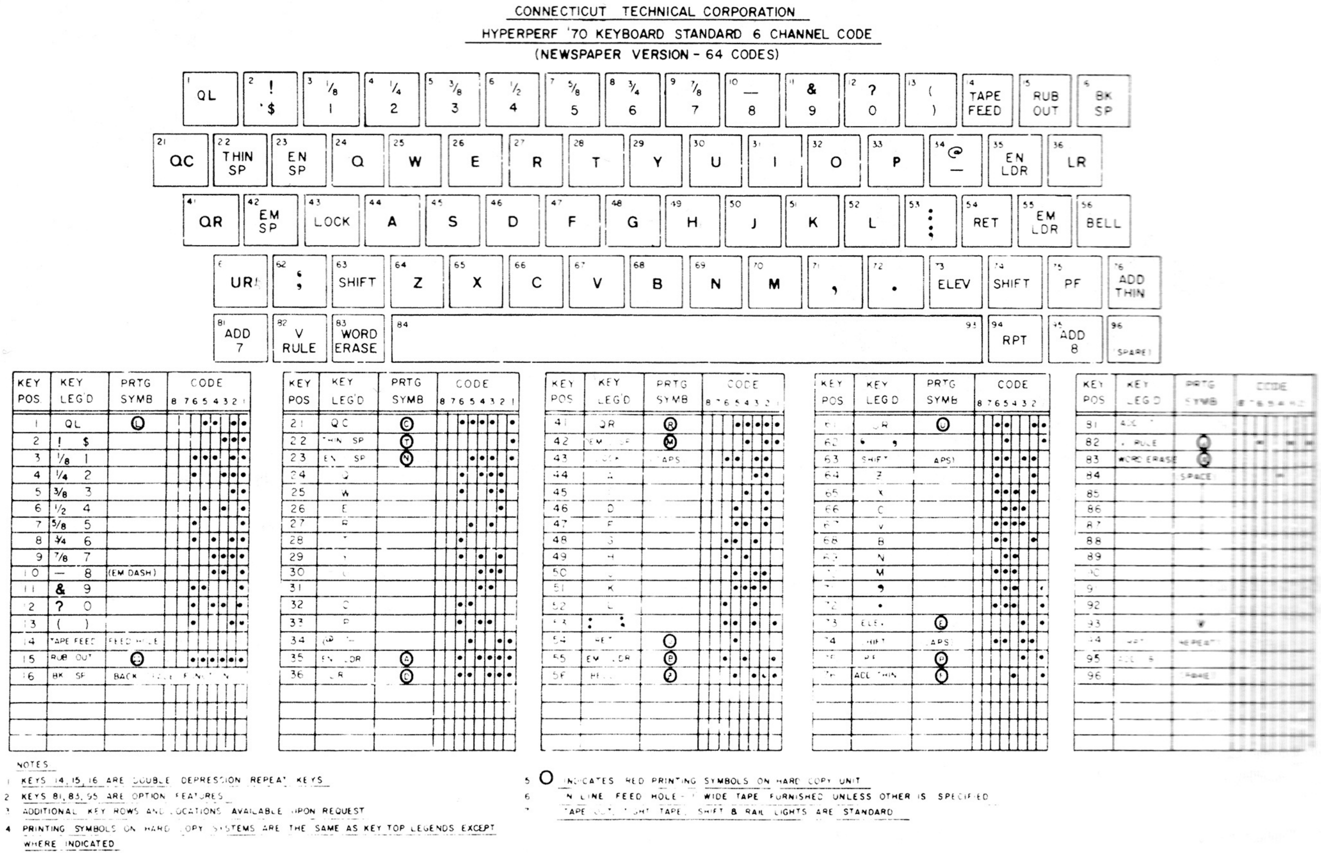
A step-by-step check list has been provided on page 1 to facilitate specifying the keyboard format and code data. Space has been provided on page 4 for additional remarks.

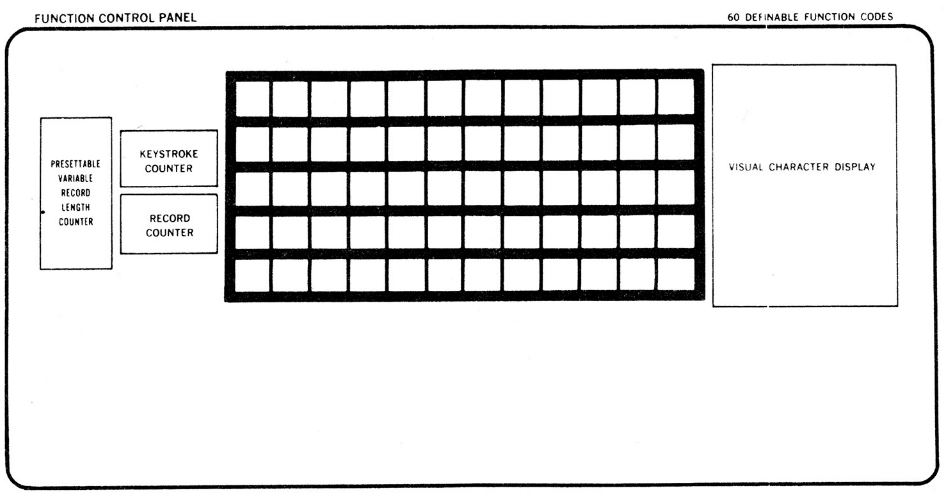
Notes:

1. Three keyboard formats are available: 48 keys, 64 keys, and 75 keys. In addition, certain keys may be arranged in either diagonal rows (as shown) or vertical rows (such as one finds on an adding machine). Unless otherwise specified the diagonal keyboard will be provided. See Table 1, page 1 for special key size. Please enter special key size in Check List under "Special Features".
2. Use key numbers for any special references such as key sizes, colors, special contacts, etc.
3. For convenience, and to minimize error, please designate code bits by repeating bit number in the appropriate space. See illustrated example on page 4.
4. See Table 2, page 1 for available keytop colors. Unless otherwise specified, Dark Blue ("B") keytops will be provided. Please enter this data in the appropriate spaces provided on the Format Chart.
5. See Table 3, page 1 for available keytop fill colors. Unless otherwise specified, White ("W") keytop fill will be provided. Please enter this data in the appropriate spaces provided on the Format Chart.

FORMAT CHART for INVAC Keyboards, Codes, and Keys.



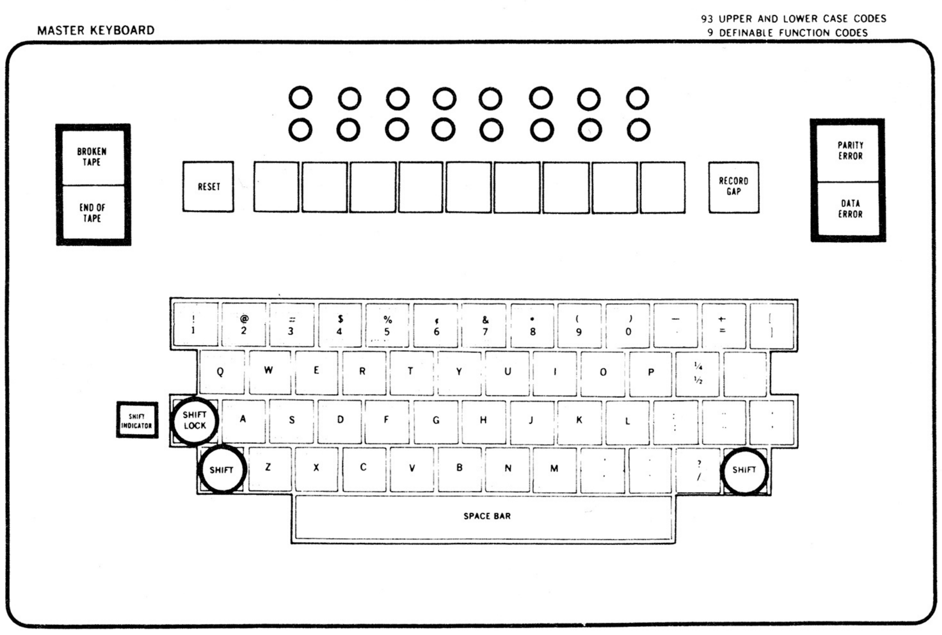


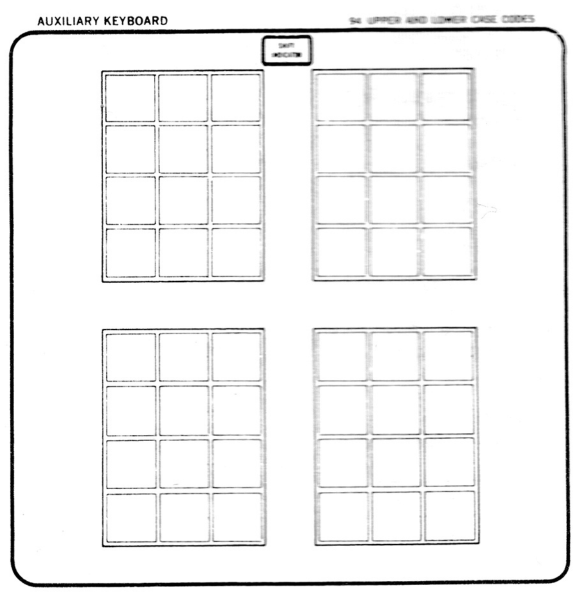


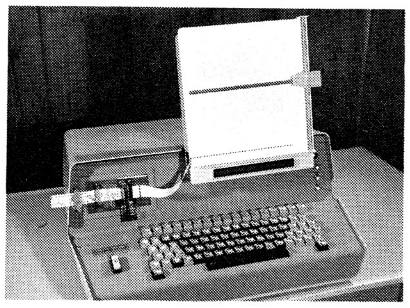
KEYMATIC DATA SYSTEMS

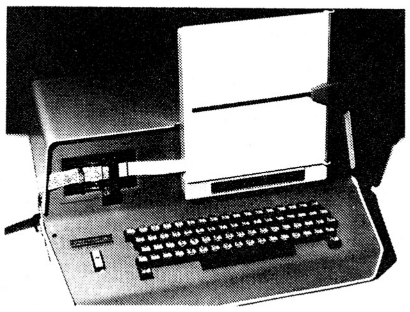
These keyboard layouts will aid you in designing your keyboard arrangements that best suit your requirements.

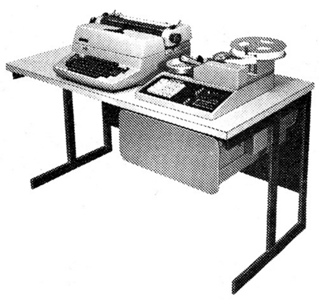
The characters you select for the "Master Keyboard" and the "Auxiliary Keyboard" will be engraved on the keys. The copy for the "Function Control Panel" will be supplied in the pushbuttons.

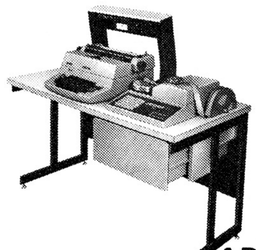


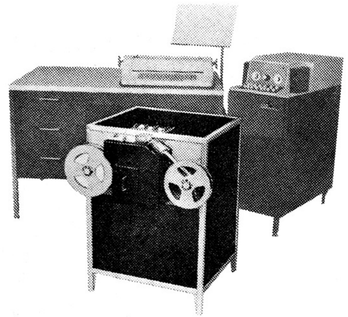










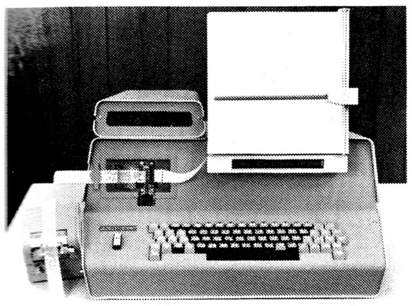


Top — l. to r.; A-M 436, 796, 789, 797.
Bottom — 430, 795, 780.

Top - l. to r.; A-M 436, 796, 789, 797.
Bottom - 430, 795, 780.

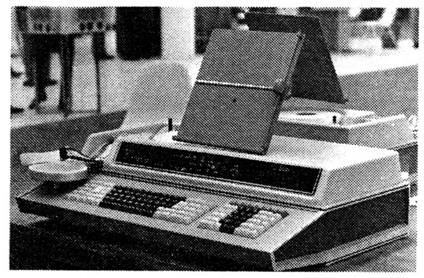
ADDRESSOGRAPH-MULTIGRAPH VARITYPER DIVISION

Model	TPE 211	TPE 212	TPE 214	Electro/Set 430	Electro/Set 432 MCK	Electro/Set 435 PMCk	Electro/Se 436
Base Price	$2500.00	$3200.00	$1700.00	$2365.00	$3715.00	$4950.00	$3450.00
Keyboard Mfg.	Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Addresso Multigrap VariType
Shift	TTS	TTS	TTS	TTS or Secr.	TTS or Secr.	TTS or Secr.	TTS or Se
Circuitry	Mech.; Elect.	Mech.; Elect.	Mech.; Elect.	Micrologic	Micrologic	Micrologic	Microlog
Hardcopy	No	No	No	No	No	No	No
Length Increment	30 Picas	30 Picas	30 Picas	—	—	—	—
Buffer/Interlock	Mechanical	Mechanical	Mechanical	Electronic	Electronic	Electronic	Electron
Visual Display	No	No	No	Optional	Optional	Optional	Optional
Justifying	Yes	Yes	No	Optional	No	Optional	Optional
Non Justifying	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Auxiliary Keyboard	No	No	No	No	No	No	No
Controls							
Auto Line Delete	No	No	No	Optional	Optional	Optional	Optional
Auto Word Delete	No	No	No	Optional	Optional	Optional	Optional
Auto Code Delete	No	No	No	Optional	Optional	Optional	Optional
Auto Col. Indent	No	No	No	—	—	—	—
Auto Add Thins	No	No	No	—	—	—	—
Indicators							
Shift Condition	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rail	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Font	No	Yes	Yes	Yes	Yes	Yes	Yes
Justify Range	Yes	Yes	—	—	—	—	—
Tight Line	Yes	Yes	—	—	—	—	—
Supershift	No	No	Yes	Yes	Yes	Yes	Yes
Tab	No	No	—	No	No	No	No
Magazine	No	Yes	Yes	Yes	Yes	Yes	Yes
Keyboard Lock	No	No	No	No	No	No	No
Other	—	—	—	—	—	—	—
Calculator Hardwire	—	—	—	—	—	—	—
Width Cards	—	—	—	—	—	—	—
Other	Fixed; Mech	Counting Magazine	—	—	—	—	—
Programmable Memory Files	—	—	—	—	7	64	2
Codes	—	—	—	6,7,8 level	6,7,8 level	6,7,8 level	6,7,8 leve
Keys	—	—	—	—	—	Yes	—
Tape	—	—	—	—	—	Yes	—
Hardwire	—	—	—	—	Removable	—	Yes
Multicode Memory Characters	64	64	64	Optional; tri-mode 192	Optional tri-mode 192	Optional tri-mode 192	Optiona mode 19
Output Coding/Level	6 level	6 level	6 level	6,7,8 level	6,7,8 level	6,7,8 level	6,7,8 leve
Speed	17-1/2 C. P. S.	17-1/2 C. P. S.	17-1/2 C. P. S.	50 C. P. S.	50 C. P. S.	50 C. P. S.	50 C. P. S
				Optional on-line or cassette capability.	Optional on-line or cassette capability.	Optional on-line or cassette capability.	Optional o or cassette ca bility.



Top: A-M 450, 432, 435.
Bottom: 460.

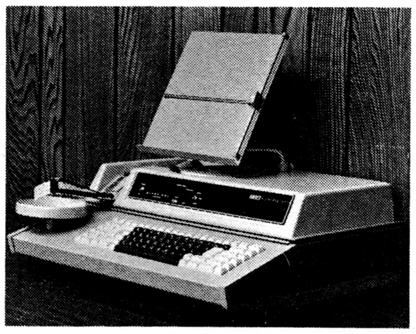
ADDRESSOGRAPH-MULTIGRAPH VARITYPER DIVISION							GRAPHITRONICS
Electro/Set 450	**Electro/Set 460**	**Electro/Set 465 PMCK**	**Electro/Set 466**	**AM 795**	**AM 796**	**AM 797**	**Graphitronics Swiftape**
$4965.00	$4900.00	$7165.00	$5485.00	$6975.00	$4295.00	$8595.00	$8600.00
Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Addressograph-Multigraph — VariTyper Div.	Automix	Automix	Automix	I.B.M. Selectric
TTS or Secr. Micrologic	TTS or Secr. Micrologic	TTS or Secr. Micrologic	TTS or Secr. Micrologic	Secr. Solid State	Secr. Solid State	Secr. Solid State	Secr. Integrated Circuits
No	No	No	No	Yes	Yes	Yes	Yes
—	99 Pica; 11 pt.	99 Pica; 11 pt.	99 Pica; 11 pt.	Picas and Points	N/A	Picas and Points	Units of Typesetting Unit
Electronic	Electronic	Electronic	Electronic	—	—		Yes; 1-line Buffer
Optional	Optional	Optional	Optional	Hard Copy	Hard Copy	Hard Copy	Hard Copy
No	Yes	Yes	Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No	No	No	No	Yes - 41 Keys	Yes - 36 Keys	Yes - 41 Keys	No
Yes	Optional	Optional	Optional	Yes	Yes	Yes	Yes
Yes	Optional	Optional	Optional	No	No	Yes	Yes - Multiple
Yes	Optional	Optional	Optional	Yes	Yes	Yes	Yes - Multiple
—	Optional	Optional	Optional	No	No	Yes	Yes
—	Optional	Optional	Optional	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	N/A	N/A	N/A	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
—	Yes	Yes	Yes	Yes	Yes	Yes	Yes
—	Yes	Yes	Yes	Yes (Overset)	Yes (Overset)	Yes (Overset)	Keyboard Locks
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No	Optional	Optional	Optional	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	N/A	N/A	N/A	Yes
No	No	No	No	Yes	N/A	Yes	Yes
—	—	—	—	—	—	—	—
—	—	—	—	—	N/A	—	No
—	—	—	—	Yes; 4 to 12 Cards; Up 4Discs	—	Yes; 8 to 24 Cards; Up 8 Discs	Yes
—	Program Tape	Program Tape	Program Tape	—	—	—	Modular
—	—	64	2	Electronic dial and toggle mechanisms allow automatic leading, line length, feed programming.	Electronic dial and toggle mechanisms allow automatic leading, line length, feed programming.	Electronic dial and toggle mechanisms allow automatic leading, line length, feed programming.	Multiple Typesetting function codes from a single keystroke.
6,7,8 level	6,7,8 level	6,7,8 level	6,7,8 level				
—	—	Yes	—				—
—	—	—	Yes				—
—	—	—	Yes	—	—	—	
Optional tri-mode 192	Optional tri-mode 192	Optional tri-mode 192	Optional tri-mode 192	Single key access to most typographic functions.	Single key access to most typographic functions.	Single key access to most typographic functions.	—
6,7,8 level	6,7,8 level	6,7,8 level	6,7,8 level	8 level	8 level	8 level	6 level
50 C. P. S.	50 C. P. S.	50 C. P. S.	C. P. S.	25 C. P. S.	25 C. P. S.	25 C. P. S.	15-1/2 C. P. S.
Optional on-line or cassette capability.	Optional on-line or cassette capability.	Optional on-line or cassette capability.	Optional on-line or cassette capability.			Merge/Edit option $2295.	

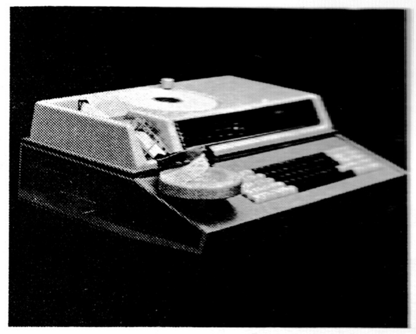
 

AUTOMIX KEYBOARDS

Model	**CIM 80**	**CIM 100**	**PCI 120**	**MPM - 6**	**FT6 - 6**	**MSQ - 4**
Base Price	$2795.00	$3495.00	$5695.00	$4995.00	$4995.00	$5045.00
Keyboard						
Mfg	AKI	AKI	AKI	AKI	AKI	AKI
Shift	Secr. or TTS	Secr. or TTS	Secr. or TTS	Secr. or TTS	Secr. or TTS	Secr. or TTS
Circuitry	Solid State	Solid State	Solid State	Solid State	Solid State	Solid State
Hardcopy	No	No	No	No	No	No
Length Increment	N/A	N/A	N/A	1/18 Em	Piclets	1/96 Pica
Buffer/Interlock	TRIPLE BUFFER (3 CHARACTER); NO INTERLOCK REQUIRED					
Visual Display	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.
Justifying	No	No	No	Yes	Yes	Yes
Non Justifying	Yes	Yes	Yes	Yes	No	Yes
Auxiliary Keyboard	No	No	Yes - 39 Keys	Yes - 40 Keys	Yes, 34 or 40 Keys	Yes - 40 Keys
Controls						
Auto Line Delete	No	No	No	Yes - Tape Command	Option	Yes - Tape Command
Auto Word Delete	Option	Option	Yes	Option	Option	Option
Auto Code Delete	No	No	No	Option	Option	Option
Auto Column Indent	No	No	No	Yes - Tape Command	No	No
Auto Add Thins	No	No	No	N/A	N/A	N/A
Indicators						
Shift Condition	Yes	Yes	Yes	Yes	Yes	Yes
Rail	Yes	No	No	No	No	No
Font	Decimal (Opt.)	No	No	Yes	Yes	Yes
Justify Range	No	No	No	Yes	Yes	Yes
Tight Line	No	No	No	Yes	Yes	Yes
Supershift	Opt.	Opt.	Opt.	Yes	Yes	No
Tab	Opt.	Opt.	Yes - Opt.	Yes	Yes	Yes
Magazine	Yes	No	No	No	No	No
Keyboard Lock	Yes	No	Yes	Yes	Yes	Yes
Other	—	Complete Format in Decimal		Complete Format in Decimal		Complete Format in Decimal
Calculator						
Hardwire	N/A	N/A	N/A	Format Entry Keyboard and Displayed in Decimal	—	—
Width Cards	—	—	—	Chips or Off-Line Mag.	Chips or Off-Line Mag.	Chips or Off-Line Mag.
Other	—	—	—	—	—	—
Programmable Memory	No	No	Yes	Option; Format Entry Keyboarded and Displayed in Decimal	Option; Formats Keyboarded and Displayed in Decimal Opt. Visual Perforation of Monitoring Instructions for line length, leading and disc.	Option; Complete Format Keyboarded and Displayed in Decimal. Format Flags need not be keyboarded - only numerical information is entered.
Files	—	—	8 - 64 Codes (a)			
Codes	—	—	16-- 32 Codes (a) 64 or 32			
Keys	—	—	8			
Tape	—	—	Opt. reader load; paper tape			
Hardwire	—	—	No - Reprogrammable			
Multicode Memory	Yes	Yes	Yes	Yes; single key access to most V-I-P functions.	Yes; single key access to most functions.	Yes; single key access to most superquick functions.
Characters	—	—	64			
Output						
Coding/Level	TTS/6 or 8	TTS; 6/8 level; programmable for others.	TTS/6 or 8	TTS for V-I-P 6/8 level	6 level TTS for Fototronic 600	TTS for Superquick/6
Speed	30 C. P. S.; BUFFERED FOR 90 C. P. S. BURST SPEEDS					
	General purpose version offers factory programmable multicodes for 8-14 keys.	Basic system offers custom multicodes on 30 to 36 keys. Versions exist for IBM 1130 &PDP-8 with DEC or CSI software; Fototronic 1200, Pacesetter, Linotronic 505,		For Merg V-I-P.	Formats keyboarded and displayed in decimal.	

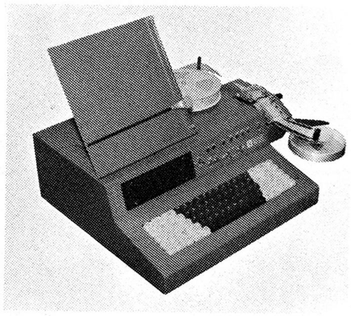
Opposite: AKI Automite CIT-70, Autocomp PCI 120.
Right: Autocomp CIM-100, Autocomp CIM-80.

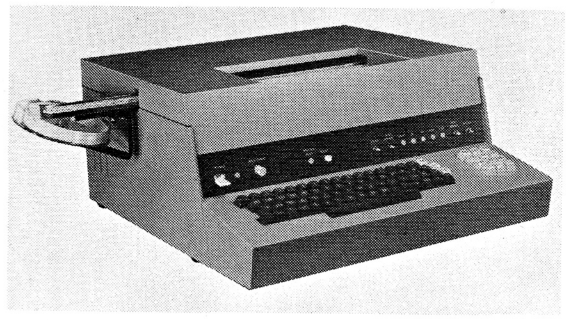




AUTOMIX KEYBOARDS

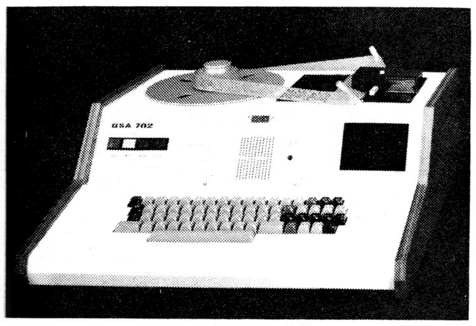
FFM - 10	HMT - 2	HMM - 4	CIT - 70	PTM 4/PTM 8	EPS 4/EPS 8	FTX - 10	PPS - 4/PPS - 8
$3595.00	$3495.00	$5995.00	$2150.00	**$4995** $5495	$4995 $5495	$5495.00	$4595 $5045
AKI	AKI	AKI	AKI	AKI	AKI	AKI	AKI
Secr. or TTS Solid State	Secr. or TTS Solid State	Secr. or TTS Solid State	Secr. or TTS Solid State	Secr. or TTS Solid State	Secr. or TTS Solid State	Secr. or TTS Solid State	Secr. or TTS Solid State
No Piclets & 1/32 Em Relative Units	No	No	No	No 1/36 Em	No 1/36 Em	No Piclets and 1/32 Em	No 1/36 Em
TRIPLE BUFFER (3 CHARACTER); NO INTERLOCK REQUIRED							
Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.	Opt.; 16 or 32 Char.
Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes - 40 Keys	No	No	No	Yes - 40 Keys	Yes - 40 Keys	Yes - 40 Keys	Yes - 40 Keys
Yes	Option	Yes (from Tape)	No	Yes - Tape Command	Yes (from Tape)	Yes - Tape Command	Yes - Tape Command
Option	Option	Option	Option	Option	Option	Option	Option
Option	Option	Option	No	Option	Option	Option	Option
No	Option	Yes	No	No	No	No	Yes - Tape Command
N/A	Option	Yes	No	N/A	N/A	N/A	N/A
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes (Ring)	Yes	Yes	Yes	No	No	No	No
Yes (Disc)	No	No	No	Yes	Yes	Yes	Yes
Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Yes	No	No	No	No	Yes	Yes	Yes
Yes	No	No	No	Yes	Yes	Yes	Yes
No	Yes	Yes	Yes	No	No	No	No
Yes	Yes	Yes	No	No	Yes	Yes	Yes
Format in Decimal	Line Length in Decimal	Line Length in Decimal	Last Code	Complete Format in Decimal	—	Complete Format in Decimal	Complete Format in Decimal
—	Yes	Yes	N/A	—	—	—	*
Chips or Off-Line Mag.	Chips	Chips	N/A	—	Chips or Off-line Mag. Tape		Chips or Off-line Mag. Tape
—	—	—	N/A	—	—	—	—
Option Complete Format Keyboarded and Displayed in Decimal. System Appends Each character for shift or super-shift. —	No — — — — —	No — — — — —	No — — — — —	Option;format entries entirely in decimal, line lengths in picas and points. Keyboard logic converts decimal entries to 713 language for perforation.	Option — — — — —	— Formats and text Stores 24 formats Up to 64 each text passage. 8 Formats only 8 " & text Reader Load (opt.) paper tape No; reprogrammable	Option Formats are keyboarded and displayed in decimal. — —
Yes; single key access to all Fototronic 1200 functions.	No —	No —	No —	Yes; single key access to most 713 functions.	Yes	Yes; single key access to most TXT functions.	Single key access to most pacesetter functions.
8/Fototronic	TTS/6	TTS (Hot Metal) - 6	TTS/6/& 7/8 bits)	Basic TTS for Photon 713; 6 or 8 level	TTS (Photon 713)	TTS/6	Basic TTS for Photon D-16 6 or 8.
30 C.P.S.; BUFFERED FOR 90 C.P.S. BURST SPEEDS							
For Fototronic 1200, 480 & TXT (8 level).	For text on linecasters.	For mixing on linecasters; line length counting reference keyboarded in picas	Coding outputs not programmable.	For Photon 713; Model 5 = PTM4; Model 10 & 20 = PTM 8.	For Pacesetter; limited to 713 language; EPS 4 for Pacesetter 4; EPS 8 for Pacesetter 8.	For Fototronic TXT (6 level only). Format entries keyboarded and displayed in decimal.	For P-16 coded Photon pacesetters; PPS-4 for Pacesetter 4; PPS-8 for Pacesetter 8.

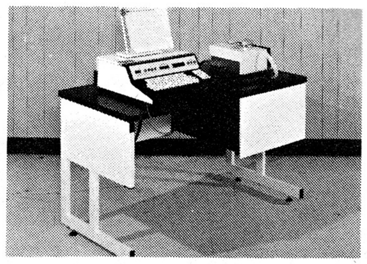


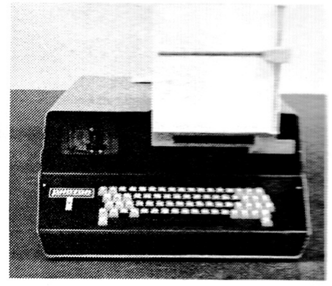


Right: Compugraphic Auto-tape, CG Dual Image.
Opposite: GSA 70, H-I 600, H-I TXT, Mergenthaler J/100, NJ/100, Photon KC-100.

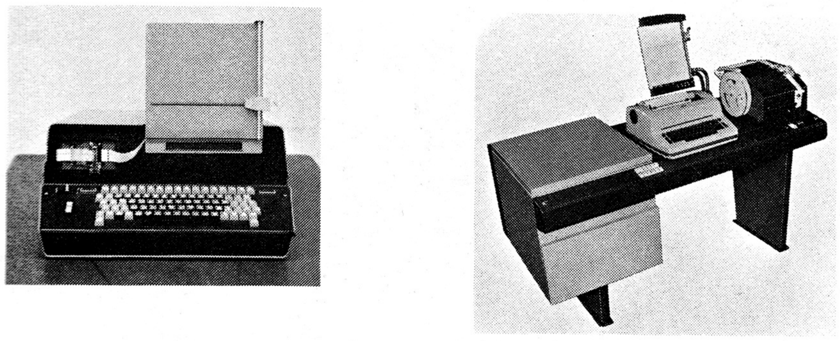
	AUTOMIX KEYBOARDS		COMPUGRAPHIC CORP.			CONN. TECH CORP.
Model	**PCI - 80**	**PCI - 100**	**Dual Image**	**Autotape**	**Autotape 9000**	**Hyperperf**
Base Price	$4195.00	$4895.00	$2200.00	$2550.00	$4500.00	$2595 (Conso
Keyboard						
Mfg.	AKI	AKI	Interface Mechanisms	Automix	Automix	Conn. Tech.
Shift	Secr. or TTS	Secr. or TTS	Secr. or TTS.	Secr. or TTS	Secr.	Secr. or TTS
Circuitry	Solid State	Solid State	Int. Cir.	Int. Cir.	Int. Cir.	Modular - Soli State
Hardcopy	No	No	Yes	No	No	Opt.($3195)
Length Increment	N/A	N/A	N/A	N/A	N/A	Points/Picas/ Units
Buffer/Interlock	TRIPLE BUFFER (3-Character)		N/A	N/A	N/A	Yes; Fully Buf fered.
Visual Display	Yes; 16 Char. (Standard); 32 Char. (Option)	Yes; 16 Char. (Standard); 32 Char. (Option)	No	Yes — 128 Char. (Option)		Opt. - 512 cha $1200.00
Justifying	No	No	No	No	No	Yes - Opt. fro $1500.00.
Non Justifying	Yes	Yes	Yes	Yes	Yes	Yes
Auxiliary Keyboard	No	No	Yes	Yes	Yes	No
Controls						
Auto Line Delete	No	No	Yes	Yes	Yes	Yes - Opt. $25
Auto Word Delete	Yes - Standard	Yes - Standard	Yes	Yes	Yes	Yes - Opt. $15
Auto Code Delete	No	No	Yes	No	No	No
Auto Col. Indent	No	No	No	No	Yes	No
Auto Add Thins	No	No	Yes	Yes	Yes	Yes - $15.00
Indicators						
Shift Condition	Yes	Yes	Yes	Yes	Yes	Yes (Standard)
Rail	Yes	No	Yes	Yes	Yes	Yes (Standard)
Font	Opt.; in Decimal	No	No	No	Yes	Yes (Opt. $20)
Justify Range	No	No	Yes	Yes	Yes	Yes (Opt. $20)
Tight Line	No	No	Yes	Yes	Yes	Yes (Opt. $20)
Supershift	Option	Option	No	No	Yes	Yes (Opt. $20)
Tab	Opt.; in Decimal	Opt., in Decimal	No	Yes	Yes	Yes (Opt. $20)
Magazine	Yes	No	Yes	Yes	Yes	Yes (Standard)
Keyboard Lock	Yes	Yes	No	No	No	No
Other	Variety of Options	Variety of Options	—	—	—	—
Calculator						
Hardwire	N/A	N/A	N/A	N/A	N/A	Yes
Width Cards	—	—	N/A	N/A	N/A	No
Other	—	—	N/A	N/A	N/A	Either Internal or Reader (Opt.
Programmable Memory						
Files	8 x 64 or 16 x 32 (Standard)	8 x 64 or 16 x 32 (Standard	N/A	N/A	N/A	Keys can be loaded from ta reader or key- board.
Codes	64 or 32	64 or 32	N/A	N/A	N/A	
Keys	8	8	N/A	N/A	N/A	
Tape	Optional reader load; paper tape	Optional reader load; paper tape	N/A	N/A	N/A	
Hardwire	No; Repro- grammable	No; Repro- grammable	N/A	N/A	N/A	
Multicode Memory						
Characters	Yes; Standard	Yes; Standard	Yes —	Yes —	Yes —	Opt; $5.00 p/code
Output						
Coding/Level	TTS (Others avail.) 6 or 8 level.	TTS (Others avail.) 6 or 8 level.	Special	6	6	TTS or other (5,6,7,8)
Speed	30 C. P. S.; Buffered for 90 C. P. S.		—	—		50 C. P. S.
	General purpose version offers custom multi- codes on 6 to 10 keys.	General purpose version offers custom multi- codes on 24 to 28 keys.	Direct input ver- sion: $2700.	Direct input ver- sion: $3225.		



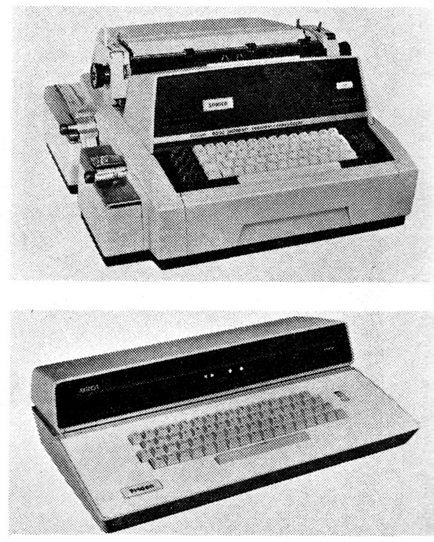




GRAPHICART	HARRIS/INTERTYPE				MERGENTHALER		PHOTON
GSA 702	Harris 600 UJ6	Harris TXT UJ6	Harris 600 J6	Harris TXT J6	J/100 VIP Keyboard	NJ/100	KC 100
9200.00	$2850.00	$3050.00	To be announced	To be announced	$5750.00	$3200.00	$2395.00
uettinger, AG, witzerland	Automix	Automix	Automix	Automix	Merg	Merg	Fairchild
ecr. nteg. Circuits	Secr. Solid State	Secr. Solid State	Secr. Solid State	Secr. Solid State	Secr. Solid State; Integrated Circuits	Secr. Same	Secr./TTS Solid State
o	No	No	No	No	No	No	No
icas/Points	N/A	N/A	1/64 Pica	1/64 Pica	1/18 Pt. System	—	Yes
es (Electronic)	TRIPLE BUFFER — NO INTERLOCK REQUIRED				Yes	Yes	Buffer
Yes	Yes - 16 Char. (Option - $800)	Yes - 16 Char. (Option - $800)	Yes - 16 Char. (Option - $800)	Yes - 16 Char. (Option - $800)	Yes; Future Opt.	Yes - Future Opt.	Yes; Opt. $1125
Yes	No	No	Yes	Yes	Yes	No	No
Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
No	No	No	Yes - 20 Keys	Yes - 20 Keys	Aux. Panel Format Option	Aux. Panel Format Option	No
No	No	No	No	No	Yes	No	Yes
Yes	Yes (Opt. $150)	Yes (Opt. $150)	Yes (Opt. $150)	Yes (Opt. $150)	Yes	Yes	Yes
No	Yes (Opt. $150)	Yes (Opt. $150)	Yes (Opt. $150)	Yes (Opt. $150)	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	No	No	No
No	No	No	Yes	Yes	Yes	No	No
No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes (Ring)	Yes (Ring)	Yes	Yes	Yes	Yes
Yes	Yes	Yes (Disc)	Yes (Disc)	Yes	Yes	Yes	Yes
Yes	No	No	Yes	Yes	Yes	No	No
Yes	No	No	Yes	Yes	Yes	No	No
Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
—	Yes	Yes	Yes	Yes	No	No	
—	Yes	Yes	Yes	Yes	Yes	Yes	—
—	No	Yes	No	Yes	Yes	Yes	No
—	—	—	—	—	—	—	—
Electronic unit w/4K-16 bits/ word core memory.	N/A	N/A	Yes	Yes	—	—	—
	—	—	No (Chips)	No (Chips)	Yes	—	—
	—	—	On-line Mag.	On-line Mag.	—	—	—
—	N/A	N/A	Yes; to 8 formats.	Yes; to 8 formats.	—	—	—
—	—		To 48	To 48	—	—	—
—	—		8/8	8 - Formats; 8 Formats & Text	Up to 16 - 32 Char. Keys	—	—
Yes (Loading)	—	—	No	No	No	—	—
	—	—	—	—	—	—	—
Yes	Yes - 18 Keys	Yes - 13 Keys	Yes - Single Key Access to Most Functions		32	—	—
6 level	TTS/6	TTS/6	TTS/6	TTS/6	6 level	6 level	6 - 8
Up to 40 C. P. S.	25 C. P. S.	25 C. P. S.	25 C. P. S.	25 C. P. S.	40 C. P. S.	40 C. P. S.	50 C. P. S.

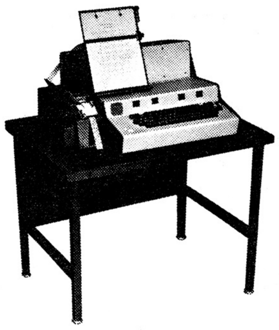


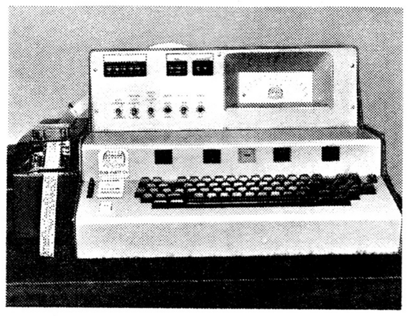
Photon KC 200
KC 500



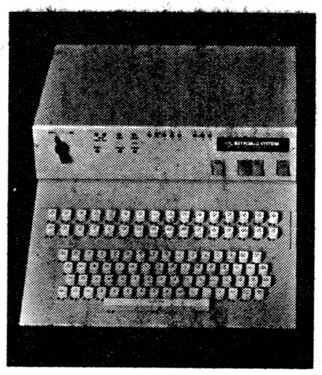
Singer 8202, 8201

	PHOTON			SINGER BUSINESS MACHINES		
Model	**KC 200**	**KC 500**	**KC 700**	**8202 Recorder**	**8202 Recorder Reproducer**	**8204 Perforator**
Base Price	$4995.00	$15000.00	$7750.00	$4085.00	$5005.00	$8050.00
Keyboard						
Mfg	Fairchild	Photon	Photon	Singer Business Machines	Singer Business Machines	Singer Business Machines
Shift	Secr./TTS	Secr.	Secr.	Secr.	Secr.	Secr.
Circuitry	Solid State	Integrated Circuits	Integrated Circuits	Electro-Mech.	Electro-Mech.	Electro-Mech.
Hardcopy	No	Yes	Yes	Yes	Yes	Yes
Length Increment	—	54 Picas	Picas	Variable	Variable	Variable
Buffer/Interlock	Buffer	Buffer	Buffer	Yes (Interlock)	Yes (Interlock)	Yes (Interlock)
Visual Display	Yes; Opt. $1125	No	No	Hardcopy	Hardcopy	Hardcopy
Justifying	No	Yes	Yes	No	No	Yes
Non Justifying	Yes	No	No	Yes	Yes	Yes
Auxiliary Keyboard	No	Yes	Yes	No	No	No
Controls						
Auto Line Delete	Yes	Yes	Yes	No	No	No
Auto Word Delete	Yes	Yes	Yes	"Kill Word" Key	"Kill Word" Key	"Kill Word" Key
Auto Code Delete	Yes	Yes	Yes	Yes	Yes	Yes
Auto Column Indent	No	Yes	Yes	No	No	No
Auto Add Thins	No	No	No	No	No	No
Indicators						
Shift Condition	Yes	Yes	Yes	Yes	Yes	Yes
Rail	Yes	Yes	Yes	Yes	Yes	Yes
Font	Yes	Yes	Yes	Yes	Yes	Yes
Justify Range	No	Yes	Yes	N/A	N/A	Yes
Tight Line	No	Yes	Yes	N/A	N/A	Yes
Supershift	—	—	Key	Yes	Yes	Yes
Tab	No	Yes	Yes	N/A	N/A	N/A
Magazine	—	—	—	Yes	Yes	Yes
Keyboard Lock	No	Yes	Yes	Yes	Yes	Yes
Other	—	—	—	—	—	—
Calculator						
Hardwire	—	8K8 Bit	4K8 Bit	N/A	N/A	No
Width Cards	—	Core Storage	Core Storage	—	—	Yes
Other	—	—	—	—	—	—
Programmable Memory						
Files	—	—	—	N/A	N/A	N/A
Codes	—	—	—	—	—	—
Keys	Yes	—	—	—	—	—
Tape	—	Yes	Yes	—	—	—
Hardwire	—	—	—	—	—	—
Multicode Memory						
Characters	32/64	—	Variable Format	N/A	N/A	N/A
Output						
Coding/Level	6 - 8	8	6 - 8	6,7,8 level	6,7,8 level	6,7,8 level
Speed	50 C. P. S.	50 C. P. S.	50 C. P. S.	200 C. P. S.	200 C. P. S.	200 C. P. S.
				1 yr. rental (includes maintenance) $128 p/month.	200 C. P. S. tape reader (standard) 1 yr. rental (includes maintenance) $150 p/month.	200 C. P. S. tape reader (standard) 1 yr. rental (includes maintenance) $253 p/month.

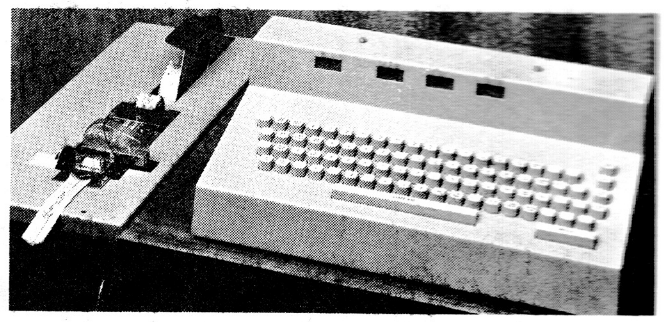




Star Autoperf



VCG D-100



VCG D-99

SINGER BUSINESS MACHINES		STAR PARTS CO.			VISUAL GRAPHICS CORP.	
8203 Recorder	**8203 Recorder Reproducer**	**Non-Counting Autoperf**	**Counting Autoperf**	**GPM Autoperf**	**Visual Graphics D-100**	**Visual Graphics D-99**
$3740.00 Singer Business Machines	$4400.00 Singer Business Machines	$2495.00 Star	$3695.00 Star	$5900.00 Star	$2300.00 Datek Systems Ltd.	$1995.00 Datek Systems Ltd.
Secr.	Secr.	Secr.	Secr.	Secr.	Secr. or TTS	Secr.
Electro-Mech.	Electro-Mech.	Printed Circuit Boards	Printed Circuit Boards	Printed Circuit Boards	Solid State; Modular Plug-in	Solid State; Modular Plug-in
Yes	Yes	No	No	No	No	No
Variable	Variable	—	18 Units	Universal (disc)	—	—
Yes (Interlock)	Yes (Interlock)	Yes	Yes	Yes	Yes	Yes
Hardcopy	Hardcopy	Yes - Opt.: ($650 - 32 Char.)	Yes - Opt.: ($650 - 32 Char.)	Yes - Opt.: ($650 - 32 Char.)	16 Characters (Option)	16 Characters (Option)
Yes	Yes	No	No	No	No	No
Optional	Optional	Yes	Yes	Yes	Yes	Yes
No	No	Yes; Option - 15 Keys w/12 codes @ ($1530)	Yes; Option - 15 Keys w/12 codes @ ($1530)	Yes; Option - 15 Keys w/12 codes @ ($1530)	No	No
Yes	Yes	—	Yes (Opt.) $250	Yes (Opt.) $250	No	No
No	No	Yes (Opt.) $250	Yes	Yes	Last Word (Opt.)	No
Yes	Yes	Yes (w/Opt.)	Yes (w/Opt.)	Yes (w/Opt.)	No	No
Yes	Yes	No	No	No	No	No
No	No	No	Yes	Yes	No	No
Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes
No	No	No	No	Yes	No	No
Yes	Yes	No	Yes	Yes	No	No
Yes	Yes	No	Yes	Yes	No	No
N/A	N/A	No	No	No	Yes	Yes
Yes	Yes	No	No	No	No	No
N/A	N/A	No	No	Yes	Yes	Yes
Yes	Yes	No	Yes	Yes	Yes	Yes
—	—	—	—	—	—	—
Yes	Yes	—	—	—	—	—
—	—	—	Yes	—	—	—
—	—	—	—	Font disc	—	—
N/A	N/A	—	—	—	—	—
—	—	—	Yes	Yes	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
N/A	N/A	—	Up to 24 Keys 30 codes each	—	Hardwire; up to 32 multicode keys, each up to 5 codes each.	Hardwire; up to 32 multicode keys, each up to 5 codes each.
7 level/Justowriter	7 level/Justowriter	6 (7/8 Opt.)	6 (7/8 Opt.)	6 (7/8 Opt.)	6,7,8 channel	6,7,8 channel
200 C. P. S.	200 C. P. S.		25 C. P. S.		Up to 40 C. P. S.	Up to 40 C. P. S.
1 yr. rental (includes maintenance) $130 p/month.	200 C. P. S. tape reader (standard) 1 yr. rental (includes maintenance) $145 p/month.					

Input Speed Translation Chart

Characters per Second	Characters per Minute	Words per Minute	Characters per Hour	Lines per Hour
1	60	10	3600	120
2	120	20	7200	240
3	180	30	10,800	360
4	240	40	14,400	480
5	300	50	18,000	600
6	360	60	21,000	720
7	420	70	25,200	840
8	480	80	28,800	960
9	540	90	32,400	1080
10	600	100	36,000	1200
11	660	110	39,600	1320
12	720	120	43,200	1440
13	780	130	46,800	1560
14	840	140	50,400	1680
15	900	150	54,000	1800
16	960	160	57,600	1920
17	1020	170	61,200	2040
18	1080	180	64,800	2160
19	1140	190	68,400	2280
20	1200	200	72,0002400	

*8 point, 11 picas, 30 characters average

4. Input media and coding

The Greeks were first again. About 300B.C., Polybius reported the following system: stations were erected at many locations which consisted of two walls about seven feet long and six feet high, separated by a space of three feet. At night, one or more torches, as needed, but no more than five, were placed on top of the walls. Certain combinations of torches represented Greek letters. Two torches on the right wall and three on the left may have stood for the letter 'H' as an example. Thus, words were spelled out letter by letter on this five-unit, center-feed "tele"-torch communication system.

In 1887 Herman Hollerith constructed the first electromechanical system for recording, computing and tabulating digital data, which he then used to record the 1890 census. Holes were punched in cards with a conductor's punch. These cards were positioned over a series of mercury-filled cups and at the touch of a lever, telescoping pins projected to the card's surface and then through, if there was a hole. The pin reaching the mercury completed an electrical circuit and and this in turn moved a pointer one position on a dial. The punched (or punch) card was one of the first methods of recording information.

A punched card measures 7 3/8 by 3 1/4 inches and is 0.007 inches thick. It contains 80 columns (the 90 column card developed by Univac was discontinued in 1966) which are numbered from left to right, 1 to 80. Vertically there are twelve rows numbered 12, 11, and then 0 to 9, from top to bottom. The two top rows are also called the X(11) and Y(12). The upper left-hand corner may be cut, or the corners rounded, depending on the system utilized. An alpha or numeric character is represented by holes punched in one or more locations of a single row. Groups of characters, or rows, such as columns 1 through 30 or 23 through 34 for example, are called fields. A field is a unique group of characters and may represent a part number or a description or an address. Thus all addresses may be put in certain columns, and we always know (as does the computer) where to find the address for comparison, sorting or correction purposes.

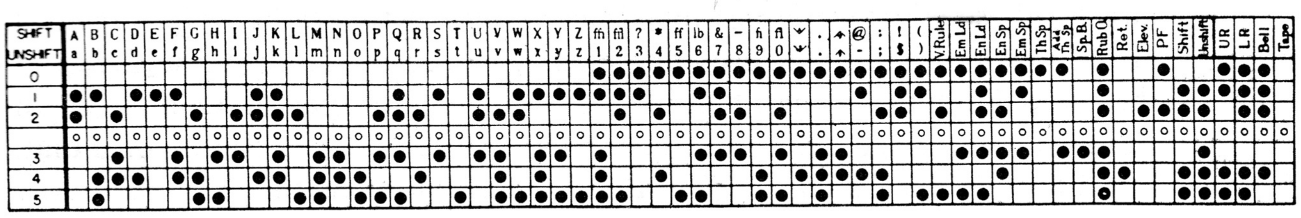
The punched card idea goes back to the early 1800's. Punched cardboard patterns were used to direct textile looms by mechanically selecting hooks which raised the longitudinal threads to make a passage for the shuttle, which "set" the crossthreads. J.M. Jacquard thus automated the weaving process and paved the way for the automatic tape operation of industrial

machinery that would come 150 years later. The punched hole was also used by the Monotype as a tiny "valve" which controlled air pressure and in turn positioned a matrix case.

Punched cards are an almost permanent recording medium. They may be retained for long periods and thus eliminate re-punching. Each card is a "slice" of information, a record, and may be changed without affecting other cards. The punched card began the unit record concept.

The early telegraph, from 1850 to 1920, used the Morse code of dots and dashes. The duration of a dot was one unit; that of a dash was three units. There were also three units between characters and six units between words. J.M.E. Baudot applied the idea of two early telegraphic developers, Gauss and Weber, of a code using five units to represent the alphabet, numerals and special symbols. This system, with some variations in character allocations, became the standard telegraphic code system. A seven unit code was devised by J.B. Moore which permitted detection of code mutilation by transmission and reception devices. A modified form of the seven unit code was later expanded by H.C.A. VanDuuren.

In 1858 Sir Charles Wheatstone employed a perforated tape to operate the telegraph transmitting mechanism. At first it was driven by a clock device and later by an electric motor. The Morse signals were received by an "inker" in which an inked wheel marked the dots and dashes on a moving tape.



The TeleTypeSetter code.

In 1915 Western Union established the multiplex system of printing telegraphy. It provided a number of independent channels of communication going in both directions at the same time on a single wire. Here, punched tape was used extensively for the first time. The Baudot five unit alphabet was used primarily. Five impulses of negative and positive current were combined to form a given letter. Thus A was represented as two positive and three negative units.

Punched tape may be paper or plastic. In either case there is always one long lengthwise row of small sprocket feed holes and five, six, seven or eight rows of larger parallel holes which represent character and function codes. Here are some of the types and forms of punched paper tape:

Oiled: tape impregnated lightly and uniformly with oil for lubrication and ease of punching.
Dry: paper tape, period.
Mylar: plastic tape which is more durable and may be re-run more often
Strip: two to four foot sections of tape.

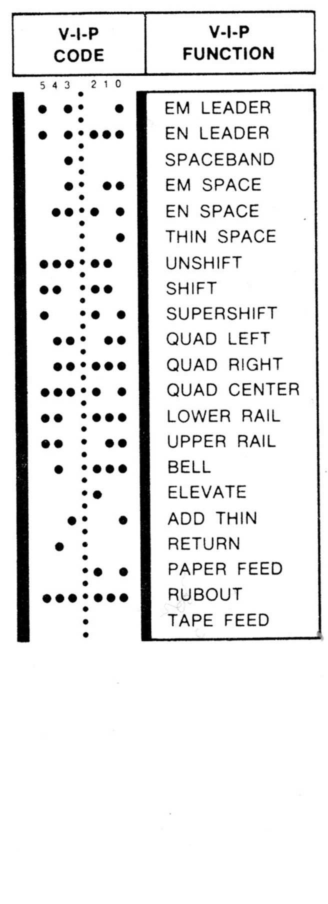
Fan-folded: tape folded every six or so inches into a stack.
Roll: about 700 feet of tape in its most used format.
Center-feed: the sprocket holes are lined up with the middle of the code holes.
Advance-feed: the sprocket holes line up with the leading edge of the code holes. This approach was developed to avoid confusion with which end goes first. When the sprocket hole is to the left of the code hole (on a right to left reader) the tape is being read correctly.

Magnetic tape is polyester plastic with a coating of magnetic particles. Invented by O. Smith in 1880, who impregnated a cotton thread with steel dust, mag tape took fifty years to perfect. Today's tape is about one half inch wide, one half mil to one and a half mils thick and 2400 feet long. Quarter, three quarter and even inch tape in various lengths is also used.

Information is recorded on the tape by magnetizing narrow strips called tracks in alternating directions. Thus, one frame of paper tape with holes representing binary codes is represented on mag tape by the presence of a magnetic flux reversal; no holes are represented by the absence of a flux reversal. 200,556, or 800 bits per inch (bpi) or code frames may be recorded. The width and bpi of mag tape is determined by the tape reader employed. Tracks are presently designated as either seven-track or nine-track, and each apply only to certain computers. A mag tape cassette is a length of magnetic tape wound so as to form a continuous loop, with an opening at which the tape may be read and recorded.

Each hole in a card or tape or flux reversal on mag represents a *bit*. Bit stands for binary digit and means *yes* or *1* or *on* if it is there, and *no* or *zero* or *off* if it is not. Here's where a little arithmetic comes in. We use a numbering system every day that is based on the number 10. In the number 567 the "7" position is digits (total: 7); the "6" position is tens (6 x 10 equals 60); the "5" position is hundreds (5 x 100 equals 500); so the number is expressed as 567. Thus we count by multiplying the number of tens in the position in which a number occurs. Going from right to left:

10^6	10^5	10^4	10^3	10^2	10^1	(10^0)
1,000,000	100,000	10,000	1,000	100	10	(1)



Command codes for the Mergenthaler V-I-P.

The above review is more than you need to know about binary arithmetic (so why tell me after I read it?); but it is a necessary introduction to coding. To encode only the numerals 0 through 9 would require codes four bits long: 0000 = 0, 0001 = 1,0010 = 2, 0011 = 3, 0100 = 4, 0101 = 5, 0110 = 6, 0111 = 7, 1000 = 8, 1001 = 9. Actually sixteen combinations are possible; not nearly enough to encode an entire alphabet. A five bit code, such as the teletype code, permits 64 possible combinations. Still inadequate for typesetting. The teletypesetter utilizes a six bit code with 128 possible combinations. Advanced typesetters require even more codes than this.

		TAPE CHANNEL NUMBERS							CHARACTER OR FUNCTION	
8	7	6 / 0	5 / 1	4 / 2	FEED	3 / 3	2 / 4	1 / 5	UNSHIFT	SHIFT
			●	●	·				a	A
			●		·		●	●	b	B
				●	·	●	●		c	C
			●		·		●		d	D
			●		·				e	E
			●		·	●	●		f	F
				●	·		●	●	g	G
					·	●		●	h	H
				●	·	●			i	I
			●	●	·		●		j	J
			●	●	·	●	●		k	K
				●	·			●	l	L
					·	●	●	●	m	M
					·	●	●		n	N
					·		●	●	o	O
				●	·	●		●	p	P
			●	●	·	●		●	q	Q
				●	·		●		r	R
			●		·	●			s	S
					·			●	t	T
			●	●	·	●			u	U
				●	·	●	●	●	v	V
			●	●	·			●	w	W
			●		·	●	●	●	x	X
			●		·	●		●	y	Y
			●		·			●	z	Z
		●	●		·	●	●	●	1	⅛
		●	●	●	·			●	2	¼
		●	●		·				3	⅜
		●		●	·		●		4	½
		●			·			●	5	⅝
		●	●		·	●		●	6	¾
		●	●	●	·	●			7	⅞
		●		●	·	●			8	EM DASH
		●			·		●	●	9	&
		●		●	·	●		●	0	?
		●			·	●	●	●	.	.
		●			·	●	●		COMMA	COMMA
		●		●	·		●	●	;	:
		●	●	●	·				$	!
		●	●		·			●	)	(
		●			·		●		APOS.	QUOTE
		●	●		·		●		HYPHEN	+
					·				TAPE FEED	
		●		●	·	●	●		EN SPACE	
		●	●	●	·	●		●	EN LEADER	
		●	●		·	●			EM SPACE	
		●			·	●		●	EM LEADER	
		●		●	·			●	VERT. RULE	
		●			·				THIN SPACE	
					·	●			SPACE BAR	
					·		●		RETURN	
				●	·				ELEVATE	
		●		●	·				PAPER FEED	
			●	●	·		●	●	SHIFT	
			●	●	·	●	●	●	UNSHIFT	
		●	●		·		●	●	UPPER RAIL	
		●	●	●	·		●	●	LOWER RAIL	
		●	●	●	·		●		STOP	
		●	●	●	·	●	●	●	RUB OUT	
		●			·	●			ADD THIN	
		●	●		·	●	●		QUAD LEFT	
		●		●	·	●	●	●	QUAD CENTER	
		●	●	●	·	●	●		QUAD RIGHT	
	●				·				ADD 7	
●					·				ADD 8	

Coding chart for the Friden 8201 keyboard.

Because the majority of phototypesetters standardized on the TTS 6-level code due to the proliferation of keyboards, newer devices require multiple codes to access certain characters and functions. Thus, some keyboards produce six-level tape with a seventh or eighth bit key to make no code more than two keystrokes. Others produce 8-level tape which provides a more complete code array.

TAPE CHANNEL NUMBERS							CHARACTER OR FUNCTION			
							UNSHIFT		SHIFT	
6	5	4	FEED	3	2	1	Lower Rail	Upper Rail	Lower Rail	Upper Rail
	●	●	•				a	a	A	A
	●		•		●	●	b	b	B	B
		●	•	●	●		c	c	C	C
	●		•		●		d	d	D	D
	●		•				e	e	E	E
	●		•	●	●		f	f	F	F
		●	•		●	●	g	g	G	G
			•	●		●	h	h	H	H
		●	•	●			i	i	I	I
	●	●	•		●		j	j	J	J
	●	●	•	●	●		k	k	K	K
		●	•			●	l	l	L	L
			•	●	●	●	m	m	M	M
			•	●	●		n	n	N	N
			•		●	●	o	o	O	O
		●	•	●		●	p	p	P	P
	●	●	•	●		●	q	q	Q	Q
		●	•		●		r	r	R	R
	●		•	●			s	s	S	S
			•			●	t	t	T	T
	●	●	•	●			u	u	U	U
		●	•	●	●	●	v	v	V	V
	●	●	•			●	w	w	W	W
	●		•	●	●	●	x	x	X	X
	●		•	●		●	y	y	Y	Y
	●		•			●	z	z	Z	U
●	●		•	●	●	●	1	V	ffi	W
●	●	●	•			●	2	B	ffl	M
●	●		•				3	C	?	
●		●	•		●		4	D	*	O
●			•			●	5	E	ff	
●	●		•	●		●	6	F	æ	K
●	●	●	•	●			7	G	&	N
●		●	•	●			8	R	—	
●			•		●	●	9	T	fi	
●		●	•	●		●	0	J	fl	Y
●			•	●	●	●	Period	Period	Period	Period
●			•	●	●		Comma	Comma	Comma	Comma
●		●	•		●	●	Semicolon		Colon	S
●	●	●	•				$	P	!	
●	●		•			●	)	Q	(	A
●			•		●		Apos./Quote	Apos./Quote	Quote	Quote
●	●		•		●		—		œ	H
			•				TAPE	FEED		
●		●	•	●	●		EN SP.	EN LD.		
●	●	●	•	●		●			EN LD.	L
●	●		•	●			EM SP.	EM LD.		
●			•	●		●			EM LD.	EM SP.
●		●	•			●	VERT. RULE	I	VERT. RULE	I
	●	●	•		●	●			SHIFT	SHIFT
	●	●	•	●	●	●	UNSHIFT	UNSHIFT		
●	●		•		●	●	UPPER	RAIL		
●	●	●	•		●	●	LOWER	RAIL		
●	●	●	•		●		STOP	CODE		
●	●	●	•	●	●	●	CODE	DELETE		
●	●		•	●	●		QUAD	LEFT		
●		●	•	●	●	●	QUAD	CENTER		
●	●	●	•	●	●		QUAD	RIGHT		
●			•				THIN	SPACE		
			•	●			SPACE	BAR		
			•		●		CARRIAGE	RETURN		
		●	•				ELEV.	ELEV.		
●		●	•				PAPER	FEED		
●			•	●			SPACE BAR and THIN SPACE			
0	1	2		3	4	5	HOT METAL EQUIVALENT			

Coding chart for the Friden LCC-VF keyboard.

DEC VALUE	UNSHIFT	5 (32)	4 (16)	3 (8)	2 (4)	1 (2)	0 (1)	SHIFT	SUPER SHIFT
00									
01	[]						●	[]	
02	e					●		E	
03	3					●	●	3/8 ·	3
04	ELEVATE				●			ELEVATE	
05	ADD POINT				●		●	ADD POINT	
06	a				●	●		A	
07	$				●	●	●	|	$
08	SPACEBAND			●				SPACEBAND	
09	KILL LINE			●			●	KILL LINE	
10	s			●		●		S	
11	□			●		●	●	□	
12	i			●	●			I	
13	8			●	●		●	EM –	8
14	u			●	●	●		U	
15	7			●	●	●	●	7/8	7
16	RETURN		●					RETURN	
17	APOS ’		●				●	‘	
18	d		●			●		D	
19	HY –		●			●	●	%	
20	r		●		●			R	
21	4		●		●		●	1/2	4
22	j		●		●	●		J	
23	COMMAND		●		●	●	●	COMMAND	
24	n		●	●				N	
25	COMMA		●	●			●	COMMA	
26	f		●	●		●		F	
27	Q L		●	●		●	●	Q L	
28	c		●	●	●			C	
29	_		●	●	●		●	_	
30	k		●	●	●	●		K	
31	Q R		●	●	●	●	●	Q R	
32	t	●						T	
33	5	●					●	5/8	5
34	z	●				●		Z	
35	)	●				●	●	(	%
36	l	●			●			L	
37	SUPER SHIFT	●			●		●	SUPERSHIFT	
38	w	●			●	●		W	
39	2	●			●	●	●	1/4	2
40	h	●		●				H	
41	EM LDR	●		●			●	EM LDR	
42	y	●		●		●		Y	
43	6	●		●		●	●	3/4	6
44	p	●		●	●			P	
45	O ZERO	●		●	●		●	?	O ZERO
46	q	●		●	●	●		Q	
47	EN LDR	●		●	●	●	●	EN LDR	
48	o	●	●					O	
49	9	●	●				●	&	9
50	b	●	●			●		B	
51	U R	●	●			●	●	U R	
52	g	●	●		●			G	
53	;	●	●		●		●	:	4
54	SHIFT	●	●		●	●		SHIFT	
55	L R	●	●		●	●	●	L R	
56	m	●	●	●				M	
57	PERIOD	●	●	●			●	PERIOD	
58	x	●	●	●		●		X	
59	1	●	●	●		●	●	1/8	1
60	v	●	●	●	●			V	
61	Q C	●	●	●	●		●	Q C	
62	UNSHIFT	●	●	●	●	●		UNSHIFT	
63	RUBOUT	●	●	●	●	●	●	RUBOUT	

DEC VALUE	UNSHIFT	5 (32)	4 (16)	3 (8)	2 (4)	1 (2)	0 (1)	SHIFT	SUPER SHIFT
00									
01	[]						●	[]	
02	e					●		E	
03	ij					●	●	3	ß
04	ELEVATE				●			ELEVATE	
05	SUPER SHIFT				●		●	SUPER SHIFT	
06	a				●	●		A	
07	CIRCUMFLEX (LC)				●	●	●	CIRCUMFLEX(UC)	
08	SPACE BAND			●				SPACE BAND	
09	DOTLESS I			●			●	DOTLESS I	
10	s			●		●		S	
11	□			●		●	●	□	
12	ı			●	●			I	
13	FIG –			●	●		●	8	
14	u			●	●	●		U	
15	ƒ			●	●	●	●	7	
16	RETURN		●					RETURN	
17	APOS ’		●				●	‘	
18	d		●			●		D	
19	HY–		●			●	●	%	
20	r		●		●			R	
21	?		●		●		●	4	»
22	j		●		●	●		J	
23	COMMAND		●		●	●	●	COMMAND	
24	n		●	●				N	
25	COMMA		●	●			●	COMMA	
26	f		●	●		●		F	
27	Q L		●	●		●	●	Q L	
28	c		●	●	●			C	
29	[]		●	●	●		●	[]	
30	k		●	●	●	●		K	
31	I UNIT SPACE		●	●	●	●	●	I UNIT SPACE	
32	t	●						T	
33	œ	●					●	5	Œ
34	z	●				●		Z	
35	)	●				●	●	(	
36	l	●			●			L	
37	` GRAVE (LC)	●			●		●	` GRAVE (UC)	
38	w	●			●	●		W	
39	ç	●			●	●	●	2	Ç
40	h	●		●				H	
41	DIERISIS (LC)	●		●			●	DIERISIS (UC)	
42	y	●		●		●		Y	
43	&	●		●		●	●	6	/
44	p	●		●	●			P	
45	*	●		●	●		●	O ZERO	
46	q	●		●	●	●		Q	
47	´ACUTE (LC)	●		●	●	●	●	´ACUTE (UC)	
48	o	●	●					O	
49	|	●	●				●	9	
50	b	●	●			●		B	
51	U R	●	●			●	●	U R	
52	g	●	●		●			G	
53	;	●	●		●		●	:	
54	SHIFT	●	●		●	●		SHIFT	
55	L R	●	●		●	●	●	L R	
56	m	●	●	●				M	
57	PERIOD	●	●	●			●	PERIOD	
58	x	●	●	●		●		X	
59	∴ □	●	●	●		●	●	1	<<
60	v	●	●	●	●			V	
61	Q C	●	●	●	●		●	Q C	
62	UNSHIFT	●	●	●	●	●		UNSHIFT	
63	RUBOUT	●	●	●	●	●	●	RUBOUT	

NOTE (UC) ACCENT FOR UPPER CASE CHARACTER
(LC) ACCENT FOR LOWER CASE CHARACTER

Coding for the V-I-P keyboard comes in two versions: left, the U.S. and British, and right, the European version.

STD. TYPESETTING CODING

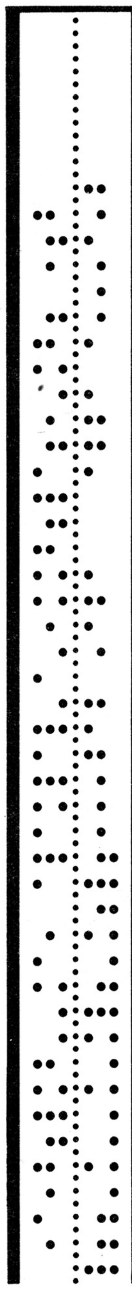
8	7	6	5	4	FEED	3	2	1	UNSHIFT	SHIFT
			●	●	·				a	A
			●		·		●	●	b	B
				●	·	●	●		c	C
			●		·		●		d	D
			●		·				e	E
			●		·	●	●		f	F
				●	·		●	●	g	G
					·	●		●	h	H
				●	·	●			i	I
			●	●	·		●		j	J
			●	●	·	●	●		k	K
				●	·			●	l	L
					·	●	●	●	m	M
					·	●	●		n	N
					·		●	●	o	O
				●	·	●		●	p	P
			●	●	·	●		●	q	Q
				●	·		●		r	R
			●		·	●			s	S
					·			●	t	T
			●	●	·	●			u	U
				●	·	●	●	●	v	V
			●	●	·			●	w	W
			●		·	●	●	●	x	X
			●		·	●		●	y	Y
			●		·			●	z	Z
		●	●		·	●	●	●	1	⅛
		●	●	●	·			●	2	¼
		●	●		·				3	⅜
		●		●	·		●		4	½
		●			·			●	5	⅝
		●	●		·	●		●	6	¾
		●	●	●	·	●			7	⅞
		●		●	·	●			8	EM DASH
		●			·		●	●	9	&
		●		●	·	●		●	0	?
		●			·	●	●	●	.	.
		●			·	●	●		COMMA	COMMA
		●		●	·		●	●	;	:
		●	●	●	·				$	!
		●	●		·			●	)	(
		●			·		●		APOS.	QUOTE
		●	●		·		●		HYPHEN	+
					·				TAPE FEED	
		●		●	·	●	●		EN SPACE	
		●	●	●	·	●		●	EN LEADER	
		●	●		·	●			EM SPACE	
		●			·	●		●	EM LEADER	
		●		●	·			●	VERT. RULE	
		●			·				THIN SPACE	
					·	●			SPACE BAR	
					·		●		CAR RETURN	
				●	·				ELEVATE	
		●		●	·				PAPER FEED	
			●	●	·		●	●	SHIFT (UC)	
			●	●	·	●	●	●	UNSHIFT (LC)	
		●	●		·		●	●	UPPER RAIL	
		●	●	●	·		●	●	LOWER RAIL	
		●	●	●	·		●		STOP (BELL) CODE	
●	●	●	●	●	·	●	●	●	RUB OUT	
		●			·	●			ADD THIN	
		●	●		·	●	●		QUAD LEFT	
		●		●	·	●	●	●	QUAD CENTER	
		●	●	●	·	●	●		QUAD RIGHT	
	●				·				ADD 7	
●					·				ADD 8	

Standard typesetting coding according to Friden. The "6" channel becomes the "0" channel in TTS.

In this section you will find some coding systems used on present day devices. Note that most are based on the teletypesetter 6-level code with modifications. In any case, the coding structure controls the number of keystrokes needed to access any character or command.

Since machines make mistakes (people are perfect) an additional bit is provided in some systems as a doublecheck on proper functioning of the code translating device, whether reader or writer. This is the "parity" bit. Using one and zero as the basic building blocks of any code produces code chains with an even or uneven number of ones. A parity bit is added to make the "byte" (a byte is a complete set of bits forming one word) even or odd (as the system dictates) and this then allows the system to detect errors and thus assure accuracy.

Character coding for the Mergenthaler V-I-P.



V-I-P STANDARD FONTS																	
UNSHIFT						SHIFT						SUPERSHIFT					
FONT LOCATION	LAYOUT / CHARACTER					FONT LOCATION	LAYOUT / CHARACTER					FONT LOCATION	LAYOUT / CHARACTER				
	P45-1	P45-2	P45-3	P34-1	P34-2		P45-1	P45-2	P45-3	P34-1	P34-2		P45-1	P45-2	P45-3	P34-1	P34-2
C13	a					C9	A										
C10	b					C4	B										
A11	c					A6	C										
B12	d					B7	D										
A13	e					A10	E										
D12	f					D7	F										
C15	g					C5	G										
D14	h					D8	H										
D13	i					D9	I										
A12	j					A7	J										
B16	k					B1	K										
C12	l					C7	L										
B11	m					B6	M										
B14	n					B9	N										
A14	o					A9	O										
D15	p					D5	P										
A16	q					A1	Q										
C11	r					C6	R										
C14	s					C8	S										
B13	t					B10	T										
D11	u					D6	U										
D10	v					D4	V										
A15	w					A5	W										
C16	x					C1	X										
B15	y					B5	Y										
D16	z					D1	Z										
A2	1					A18	⅛	⅛	/	+	¶	A22	1	1	1	° Deg	[
B2	2					B18	¼	¼	¼	Minus	§	B22	2	2	2	′ Min	]
C2	3					C18	⅜	⅜	⅓	⅓	⅓	C22	3	3	3	●	⧫
D2	4					D18	½	½	½	×	†	D22	4	4	4	•	⧫
A3	5					A19	⅝	⅝	⅔	⅔	⅔	A23	5	5	5	★	☆
B3	6					B19	¾	¾	¾	=	‡	B23	6	6	6	★	☆
C3	7					C19	⅞	⅞	En Ld	En Ld	÷	C23	7	7	7	✓	#
D3	8					D19	Em	Minus	Em	Em	Em	D23	8	8	8	■	⬆
A4	9					A20	&					A24	9	9	9	□	⬇
B4	0					B20	?					B24	0	0	0	©	@
A8	PERIOD					A8	PERIOD										
B8	COMMA					B8	COMMA										
D17	;					C20	:					C24	¢	¢	¢	®	TM
B17	'					A17	'										
D21	)					C21	(					(A21)	%	+	%	/	/
C17	HYPHEN					A21	%	+	%	/	/						
B21	$					D20	!					D24	$	$	$	*	℅

Mirror image coding is used for certain input systems; it "flops" the tape. Thus the character 'a' which was 54 is now 32.

MIRROR IMAGE CODING

TAPE CHANNEL NUMBERS									CHARACTER OR FUNCTION	
8	7	6	5	4	FEED	3	2	1	UNSHIFT	SHIFT
					·	●	●		a	A
		●	●		·		●		b	B
			●	●	·	●			c	C
			●		·		●		d	D
					·		●		e	E
			●	●	·		●		f	F
		●	●		·	●			g	G
		●		●	·				h	H
				●	·	●			i	I
			●		·	●	●		j	J
			●	●	·	●	●		k	K
		●			·	●			l	L
		●	●	●	·				m	M
			●	●	·				n	N
		●	●		·				o	O
		●		●	·	●			p	P
		●		●	·	●	●		q	Q
			●		·	●			r	R
				●	·		●		s	S
		●			·				t	T
				●	·	●	●		u	U
		●	●	●	·	●			v	V
		●			·	●	●		w	W
		●	●	●	·		●		x	X
		●		●	·		●		y	Y
		●			·		●		z	Z
		●	●	●	·		●	●	1	⅛
		●			·	●	●	●	2	¼
					·		●	●	3	⅜
			●		·	●		●	4	½
		●			·			●	5	⅝
		●		●	·		●	●	6	¾
				●	·	●	●	●	7	⅞
				●	·	●		●	8	EM DASH
		●	●		·			●	9	&
		●		●	·	●		●	0	?
		●	●	●	·			●	.	.
			●	●	·			●	COMMA	COMMA
		●	●		·	●		●	;	:
					·	●	●	●	$	!
		●			·		●	●	)	(
			●		·			●	APOS.	QUOTE
			●		·		●	●	HYPHEN	+
					·				TAPE FEED	
			●	●	·	●		●	EN SPACE	
		●		●	·	●	●	●	EN LEADER	
				●	·		●	●	EM SPACE	
		●		●	·			●	EM LEADER	
		●			·	●		●	VERT. RULE	
					·			●	THIN SPACE	
				●	·				SPACE BAR	
			●		·				CAR RETURN	
					·	●			ELEVATE	
					·	●		●	LM	
		●	●		·	●	●		SHIFT (UC)	
		●	●	●	·	●	●		UNSHIFT (LC)	
		●	●		·		●	●	UPPER RAIL	
		●	●		·	●	●	●	LOWER RAIL	
			●		·	●	●	●	STOP (BELL) CODE	
●	●	●	●	●	·	●	●	●	RUB OUT	
				●	·			●	ADD THIN	
			●	●	·		●	●	QUAD LEFT	
		●	●	●	·	●		●	QUAD CENTER	
			●	●	·	●	●	●	UM	
	●				·				ADD 7	
●					·				ADD 8	

8	7	6	5	4	FEED	3	2	1	PHOTON INSTRUCTIONS	CODE + 7 BIT
	●		●		·	●	●	●	LENS POS. 1	STOP CODE
	●		●		·	●	●		LENS POS. 2	J
	●		●		·	●			LENS POS. 3	R
	●		●		·	●		●	LENS POS. 4	4
	●		●		·			●	LENS POS. 5	QUOTE
	●		●		·				LENS POS. 6	CAR RET
	●		●		·		●		LENS POS. 7	D
	●		●		·		●	●	LENS POS. 8	HYPHEN
	●				·	●	●		LEADING	A
	●				·		●		LOWER PAIR	E
	●				·			●	UPPER PAIR	THIN SPACE
	●		●	●	·				LINE LENGTH	N
	●				·		●	●	KILL LINE	3
	●				·	●	●	●	ADD LEAD	$
	●				·	●		●	QR	LM
	●				·	●			1 UNIT	ELEVATE

Code Line	Channel						Code Assignment		Code Assignment		Code Line
	5	4	3	2	1	0	Unshift	Shift	Unshift	Shift	
0			·				Tape Feed	Tape Feed	Tape Feed	Tape Feed	0
1			·			●	Thin Space	Thin Space			1
2			·		●		e	E			2
3			·		●	●	3	3/8			3
4			·	●			Elevate	Elevate	Elevate	Elevate	4
5			·	●		●	Paper Feed	Paper Feed	Grid 2	Grid 2	5
6			·	●	●		a	A			6
7			·	●	●	●	$	!			7
8			●·				Spaceband	Spaceband	Spaceband	Spaceband	8
9			●·			●	Add Thin Sp.	Add Thin Sp.	Add thin Sp./Grid 4	Add thin Sp./Grid 4	9
10			●·		●		s	S			10
11			●·		●	●	EM Space	EM Space			11
12			●·	●			i	I			12
13			●·	●		●	8	EM Dash			13
14			●·	●	●		u	U			14
15			●·	●	●	●	7	7/8			15
16		●	·				Return	Return			16
17		●	·			●	✓	✓			17
18		●	·		●		d	D			18
19		●	·		●	●	Hyphen	@			19
20		●	·	●			r	R			20
21		●	·	●		●	4	1/2			21
22		●	·	●	●		j	J			22
23		●	·	●	●	●	Bell	Bell	Grid 3	Grid 3	23
24		●	●·				n	N			24
25		●	●·			●	Comma	Comma			25
26		●	●·		●		f	F			26
27		●	●·		●	●			Quad Left	Quad Left	27
28		●	●·	●			c	C			28
29		●	●·	●		●	EN Space	EN Space			29
30		●	●·	●	●		k	K			30
31		●	●·	●	●	●			Quad Right/Grid 1	Quad Right/Grid 1	31
32	●		·				t	T			32
33	●		·			●	5	5/8			33
34	●		·		●		z	Z			34
35	●		·		●	●	)	(			35
36	●		·	●			l	L			36
37	●		·	●		●	EM SR/Vert. Rule	EM SR/Vert. Rule			37
38	●		·	●	●		w	W			38
39	●		·	●	●	●	2	1/4			39
40	●		●·				h	H			40
41	●		●·			●	EM Leader	EM Leader			41
42	●		●·		●		y	Y			42
43	●		●·		●	●	6	3/4			43
44	●		●·	●			p	P			44
45	●		●·	●		●	¢	?			45
46	●		●·	●	●		q	Q			46
47	●		●·	●	●	●	EN Leader	EN Leader			47
48	●	●	·				o	O			48
49	●	●	·			●	9	&			49
50	●	●	·		●		b	B			50
51	●	●	·		●	●	Upper Rail	Upper Rail	Upper Rail	Upper Rail	51
52	●	●	·	●			g	G			52
53	●	●	·	●		●	;	:			53
54	●	●	·	●	●		Shift	Shift	Shift	Shift	54
55	●	●	·	●	●	●	Lower Rail	Lower Rail	Lower Rail	Lower Rail	55
56	●	●	●·				m	M			56
57	●	●	●·			●	Period	Period			57
58	●	●	●·		●		x	X			58
59	●	●	●·		●	●	1	1/8			59
60	●	●	●·	●			v	V			60
61	●	●	●·	●		●			Quad Center	Quad Center	61
62	●	●	●·	●	●		Unshift	Unshift	Unshift	Unshift	62
63	●	●	●·	●	●	●	Rub Out	Rub Out	Rub Out	Rub Out	

Character and command coding for the Mergenthaler Super Quick.

Two newer code systems are being used with greater frequency in an attempt to standardize information transfer. The first is the United States of America Standard Code for Information Interchange (USASCII or ASCII) and the other is the Extended Binary Coded Decimal Interchange Code (EBCIDIC). Each provides a larger array of code possibilities than are possible on TTS, the unofficial standard of the industry. These new code systems provide a unique code for each character or command rather than shift, unshift precedence coding (two frames for one capital letter, for instance).

5. Punched card input systems

The RACE II System from Warlock Computer Corporation uses punched cards rather than perforated paper tape as the means of communication between the typesetting keyboard and the phototypesetter. It does not limit the capabilities of the keyboard but adds the functions of a data processing system, such as:

Random Access — The random access capability makes it possible to locate any text line or group of text lines by simply reading the legend at the top of the punched card. Once located, text lines may be changed, deleted, or rearranged as desired.

Editing and Updating — The ability to easily edit or update material such as price lists, directories, parts lists, etc., which are subject to periodic reruns with changes.

Manipulation — The ability to manipulate material to be typeset using high speed card sorting (unit record) equipment where the size or economics of the job do not justify fully computerized storage and manipulation. In this way, a variety of reports to be typeset may be produced from one carefully organized deck of cards.

Computer Access — The ability to typeset material which is already stored and manipulated in a standard business computer directly without requiring special hardware which is not readily available.

The RACE II Card Input System consists basically of two components, the Keyboard Interpeter Unit (KIU) and the Typesetter Interface Unit (TIU).

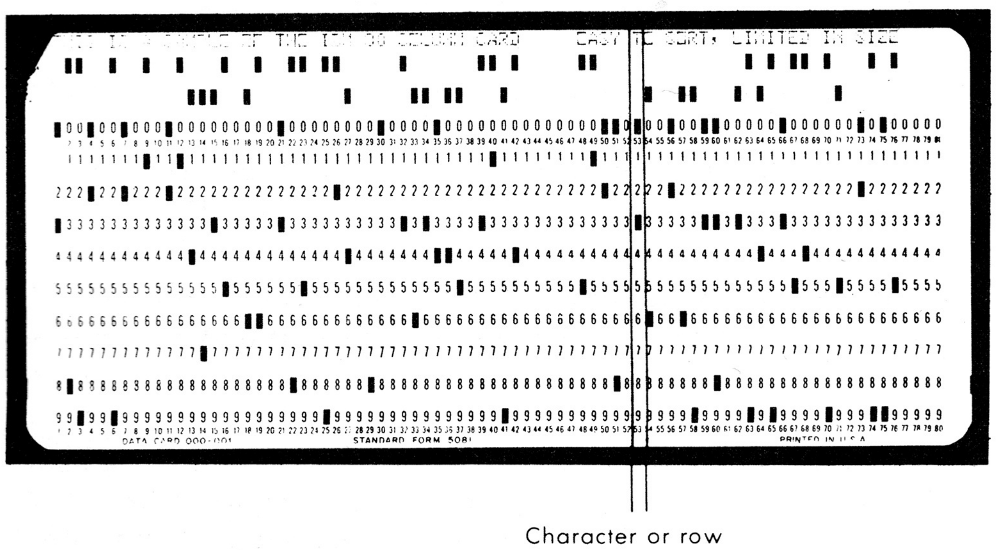
Keyboard Interpreter Unit — The Keyboard Interpeter Unit (KIU) provides the means for generating punched cards, using a standard typesetting keyboard. The unit serves as a link between a typesetting keyboard and an IBM Keypunch, Model 026 or 029.

Typesetter Interface Unit (TIU) — The Typesetter Interface Unit is used to transmit data from punched cards to the Phototypesetter system.

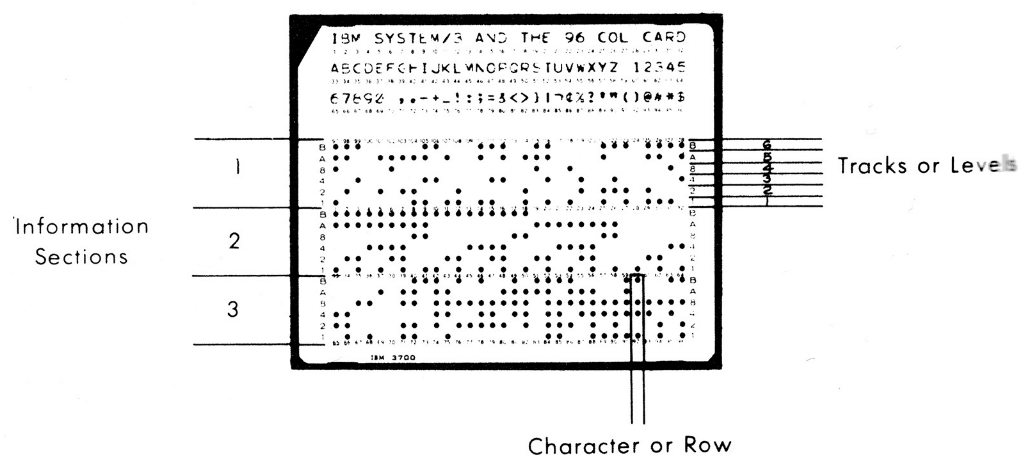
The KIU is connected directly to the punch drive circuit of the typesetting keyboard. As the operator of the keyboard prepares the copy, data in the

code format of the keyboard is routed through the connecting cable to the KIU. The KIU circuitry converts the data from the code format of the keyboard to Hollerith coding and then drives an IBM Keypunch to enter the data on cards.

The Console of the TIU is interfaced between the tape reader of the phototypesetter and the logic circuits of the typesetter. Controls on the Console enable the operator to select either paper tape or cards as the input medium to the phototypesetter. When in the paper tape mode of operation, the signals from the tape reader are routed directly through the output cable to the phototypesetter. When in the card mode of operation, signals from the card reader are routed to the Converter Cabinet of the TIU where the Hollerith formatted signals are converted to TTS code or appropriate typesetter code format. The signals are routed through the Console to the phototypesetter which reads the data as though it originated on paper tape. The Console also makes it possible for the operator to select the column on the card where reading will begin, the column where reading will end, and the first and last columns within the card which identify a block of information to be deleted.



A standard eighty column punched card.



An IBM System 3 punched card.

Each keystroke at the keyboard will cause one column to be punched on the card. The alphabet and the numerals are printed at the top of the card with alphabetic characters appearing as capital letters regardless of the shift or unshift condition of the keyboard at the time. In addition to the alphabet and numerals, the period, comma, hyphen, fraction bar and several special characters print out at the top of the card. The special characters are used to indicate the most frequently used function codes. This makes it easier to determine that a card has been prepared correctly than trying to read the punched codes. Some function codes will be punched on the card but will not print a symbol at the top of the column.

The function codes for line length, leading, point size and typeface are keyboarded as though the information were being entered on tape. These instructions should be followed by a carriage return to insure that the line parameters are on a single card which may be replaced, if in error, or duplicated, with the duplicate cards inserted in the deck where needed to avoid keyboarding the information each time it is required. Normal straight matter is keyboarded just as if the information were being placed on paper tape, terminating each line with a carriage return. This will automatically release the card and register a new one ready for the next line. Under certain circumstances, it is possible for the operator to get ahead of the keypunch after a carriage return, resulting in the loss of codes on the card. This occurs when the carriage on the keyboard completes its return to the left margin faster than the keypunch can release one card and register a new one. The operator should develop the habit of coordinating the typing operation with the keypunch rather than the keyboard. Lines exceeding eighty codes must be continued on another card. If the line can be terminated before the end of the card, no futher attention is required. If the line must be continued on the next card, it is necessary for the operator to depress the REL key of the keypunch, wait until the new card has registered and then complete the line, ending with a carriage return.

Certain tabular runs may have columns to be deleted in some galleys and added in others. For example: (a) A large number of items that require automatic card sorting in accordance with coded categoried i.e. brass, iron, plastic, wood parts, etc. (b) Wholesale/retail prices to be produced from the same deck. (c) Customer billing information such as in classified advertisements. In this case, the Card Length and Field Delete switches are used to identify the fields (columns) on the card which are to be typeset. If the information to be deleted is at the front of the card, set the Card Length Begin switch to identify *the last column to be ignored.* If the information to be deleted is at the end of the card, set the Card Length End switches to identify the last card column to be read and the Field Delete End switches to identify the last column to be deleted. The system will run faster if information to be deleted is at the end of the card rather than the beginning. This is due to the fact that the phototypesetter begins flashing a line following carriage return while the reader ejects the card, inserts a new card, and then waits for the "START" signal from the phototypesetter before reading the new card. It is more efficient to allorbefore reading the new card. It is more efficient to allow the card reader to pass over deleted information while the phototypesetter is flashing, than to force the phototypesetter to wait during this period.

In the normal mode of operation, keystrokes are duplicated on cards column by column. That is, each keystroke produces a corresponding punched code in the card. The alphabet and the numerals are printed at the top of the card and since the keypunch has only one "case", the legend at the top of the card will always appear as capital letters or numbers regardless of the "shift" or "unshift" condition of the keyboard.

In addition to the alphabetical characters and numerals, periods, commas, hyphens, fraction bars and several additional special characters are also printed on the top of the card. The special characters are used to indicate the most frequently used function codes which makes it easier to determine if a card has been correctly punched.

It is a matter of convenience whether or not function codes are placed on the same card with the text matter or are placed on separate cards. Placing the function codes on the same cards with the text will sometimes reduce the size of a deck significantly as well as eliminate the possibility of misplacing of these codes. On the other hand, if function codes are placed on separate cards, it will be easier to change formatting of instructions such as leading and font, in case this should be required after initial keyboarding is completed i.e. increasing or decreasing the leading point in order to achieve a better copy fit.

The flexibility of the keypunch and the RACE II Card Input System as well as the variety of keyboards which can be used with this system make it impossible to anticipate all possible combinations of tab requirements. The following paragraphs, therefore, describe a few typical examples in order to illustrate the basic principles of tabular work.

Examine the list for longest part number, longest nomenclature, or longest retail and wholesale prices, including the dollar sign. Keyboard the composite "longest line" using fixed spaces between part number and nomenclature, and between retail and wholesale prices, and use J-spaces between nomenclature and retail price. A test setting of the text line can be made to determine the final line length to be used in the typesetter or else, the line length can be calculated from a character count and/or the character width tables available in the appropriate typesetter Manual.

From this card, a program card for the keypunch is made up which causes the RACE II Card Input System to perform repetitive operations automatically.

The sequence of subsequent operations is as follows:

(1) The keypunch registers a card, punches the lower case code and then stops.

(2) The operator keyboards the part number and depresses the SKIP key.

(3) The keypunch punches the tab codes, shift code and "Quad Left" code for the nomenclature column, and then stops.

(4) The operator keyboards the nomenclature, shifting and unshifting as necessary, and depresses the SKIP key.

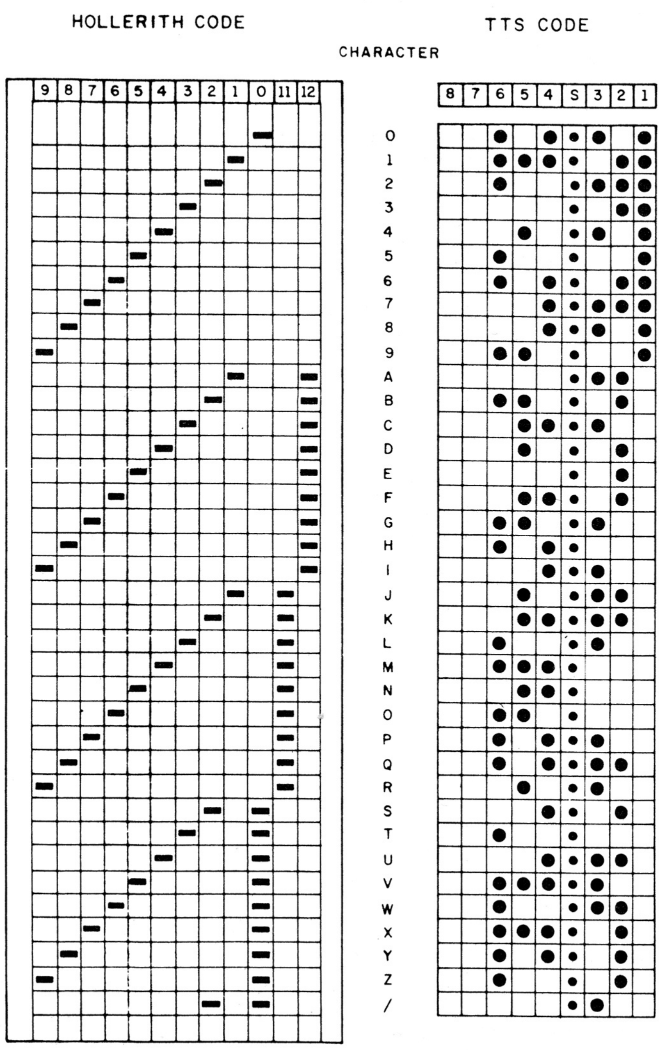
(5) The keypunch skips over the remaining columns of the nomenclature field, and then punches in the tab codes and a "Quad Right" code for the retail price column and stops.

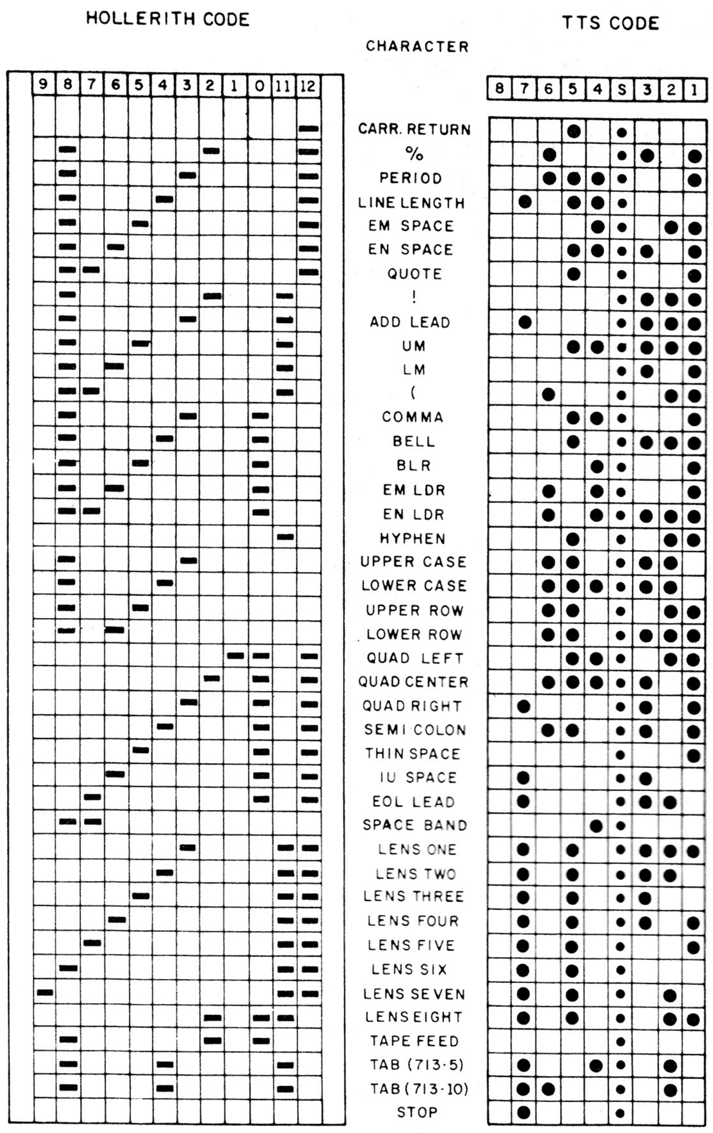
(6) The operator keyboards the dollar sign and/or fixed spaces plus the retail price, as required, and depresses the SKIP key.

(7) The keypunch punches in the tab codes, the "Quad Right" code for the wholesale column, and stops.

(8) The operator keyboards the wholesale price in the same manner as the retail price, described in (6) above, and depresses the SKIP key.

(9) The keypunch releases the card, registers a new card, punches the unshift code, and stops, ready for the next line.





A conversion chart of Hollerith (punched card codes) and TTS coding.

```
100111 BRAHMS - Sonata In F Minor For Clarinet And Piano/$13.50
       Sonata In E-Flat Major For Clarinet and Piano -
       Harold Wright, Clarinet; Harris Goldsmith, Piano
```

The fixed information in this example is much greater than the variable information. Furthermore, for the purposes of ths example, it is also assumed that the variable information changes frequently. Examine the copy for the longest part number and the longest price. Either a test setting can be made, or else the width can be calculated from a character count and/or character width table. The space remaining can be devoted to the nomenclature and description columns. Since the price changes frequently and only represents a small part of the total text, it is best to place it on a card by itself. Keyboarding would proceed as follows:

(1) With the regular program card on the keypunch and the starwheels down, keyboard part number, "TAB", the first line of text matter to justification, "TAB" and "Quad Right" codes, and depress the "REL" key.

(2) Keypunch registers a new card.

(3) Operator keyboards the price and a "Carriage Return".

(4) Keypunch registers a new card.

(5) Operator keyboards "TAB", the second line of text matter to justification, and a "Carriage Return".

(6) Keypunch registers a new card. Additional lines of text matter are keyboarded as in (5) above until the text is completed.

(7) Start the second item as in (1) above.

Price revisions can be keyboarded most efficiently in one continuous operation and be inserted into the card deck in a second operation. This will reduce greatly the possibility of human error. The use of colored cards can be a help in locating price cards or in keeping track of new versus old prices.

The following is an explanation of the terms used in the RACE II Card Input System.

Column

The RACE II Card Input System uses standard 80 column cards. A column has twelve possible punch positions, sometimes referred to as "twelve levels". Each column is equivalent to one code frame on perforated paper tapes. Columns are numbered 1 through 80 with column numbers normally

printed on the face of the card. In conversation be careful to distinguish between a "card column" and a "column of tabular copy".

DUP

This stands for "Duplicate". The use of this keypunch key permits duplication of information from one card to another. However, it does NOT duplicate information from the program card.

Field

A group of columns on a punched card may be referred to as a "Field." For example, a group of columns on a punched card which contains a price might be referred to as the "Price Field". Similarly there may be a "Date Field", a "Name Field", etc.

Format Card

This term refers to a card which contains format instructions for the typesetter. Do not confuse it with a Program Card used on the Keypunch.

Line Card

A card which contains nothing but a carriage return (line space) code is called a "line card". It produces an amount of leading which is equal to the primary leading programmed into the typesetter.

Program Card

A program card is used on the program drum of the keypunch to control the automatic functions of the keypunch. No information is transferred from the program card to the card currently being punched. The program card excercises control over which columns of information are to be duplicated from the card in the read station to the card in the punch station, or which columns are to be skipped entirely.

Program Drum

This is the drum in the keypunch which holds the program card. When the starwheels are down, the program card controls the automatic functions of the keypunch. When the starwheels are in the up position, control of the keypunch is performed manually.

Rel

This key on the keypunch causes the card in the punch station to be released and a new card to be registered.

Row

The cards used by the RACE II Card Input System have twelve "rows". The "twelve" row is located at the top of the card, immediately below the printed

legend. The next row then is "eleven", "zero", "one", "two", "three", "four", "five", "six", "seven", "eight", "nine", in that order down the card.

Run-Out Card

A card with sufficient "add-leads" to advance the paper in the magazine after a run on the typesetter is used in place of the manual leading.

Skip

Depressing this key on the keypunch causes the card to advance rapidly to the next field as defined by the program card. With the program card used for normal text, the card will skip the remainder of the card, and a new card will be registered in the punch station.

Stop Card

This is a card with a "stop" code plus a "tape feed" (blank frame or column) code which is placed at the end of a deck of cards to be run. If it is at the end of a take, it should be preceded by a "run-out" card.

6. Video display terminal (VDT) systems

There are over 200 video display terminals on the market. Some are the alphanumeric type and show numbers, letters and special symbols on the screen. Others are "graphic" terminals with the ability to draw lines on the screen and thereby display representations of three-dimensional objects.

The video display terminals used in typesetting today are alphanumeric, varying from simple models which can display only a few hundred cap characters to those which may indicate different "typefaces" on the screen.

A video display terminal is a special kind of television. An electron gun projects a stream of electrons onto a phosphor coating on the face of the tube, causing the tube to glow. The color of the image varies with the kind of coating inside or the tinted screen which is over the front of the tube.

The phosphor coating is excited to a state of fluorescence that has a degree of persistence (it takes a time for the image to fade). If the phosphor fades quickly the image fades likewise. Because the image projected on the face of the tube begins to fade it must be refreshed or displayed over and over again for the image to appear stable on the face of the tube. This means that the information to be displayed must be held in some sort of buffer memory and recycled many times a second to achieve a reasonably flicker free image.

Video terminals may be configured in a wide variety of different ways. There is the totally self-contained editing terminal which does not need a computer. This unit reads text in from paper tape, displays it on the screen to be modified and then repunches the corrected version as a clean tape.

Diff kinds

There is also the slave unit with virtually no logic of its own. This unit must be wired directly to a computer. In between these units is the stand-alone computer terminal connected to a computer to accept or deliver hunks of text, but with its own logic for storage of the text to be displayed on the screen and for making changes in this text. Lastly, there is the cluster terminal which shares logic among several separate stations.

Characters are formed on the face of a VDT tube in the following ways:

1. Characters are created out of a series of dots. Most are designed to form a rectangle five dots wide by seven dots high (a 5 x 7 dot matrix). It is difficult to design legible lowercase letters within these constraints and some VDT's

have gone to a 7 x 9 or greater matrix. A dot matrix pattern is well suited to a television tube with its fixed raster scan. This can, in effect, make any TV a terminal.

2. Characters are created out of a series of line segments. This is called vector generated characters and is less commonly used.

3. Another approach is to "paint" the characters with a series of horizontal or vertical strokes (raster scan), in a manner similar to that used on most CRT typesetters — although, of course, with much lower resolution.

The number of characters which may be displayed on the tube at one time is a function of the resolution of the tube. The more addressable points there are on a tube, and the fewer addressable points required to describe each character, the more characters will fit on the screen at one time. The size of the tube itself is of relatively little consequence in determining how much information will fit on the screen. You get the same picture information on a 7" T.V. tube as you do on a 21" tube. You may prefer the 21" tube because it is larger, but all you are really seeing is an enlarged and more legible version of the same picture.

Most of the VDT's which are commercially available are not aimed specifically at the typesetting market and have limited character sets — often about 64 separate symbols, which means upper case characters only and very few special symbols. Increasingly, greater numbers of upper and lower case alphanumeric terminals are coming on the market. Most of these will display over 96 separate symbols. Some will display as many as 128.

There are three basic elements common to VDT units: a) Refresh logic, b) Character generation, and c) Editing electronics. As characters enter the VDT via keyboard, paper tape or by direct cable, they are stored in the refresh logic. From here the characters are projected on the face of the cathode ray tube sixty times a second. This cycle is necessary so that the image on the screen appears stable. The shape and characteristics of each character are produced by character generation circuitry.

On most units, the character location on the screen at which the on-going operation takes place is defined by a "cursor." This may be an underline dash or an entire rectangle, often having a "blinking" appearance for ease in location on a screen full of characters. The cursor is the key to most VDT editing. It is positioned by means of control keys that move it up, down, left and right. Some VDTs also have a "home" key to bring the cursor to the first location in the left hand corner of the screen. Additonal commands may move it to the end of a paragraph or to other locations. It is also used to delineate the character, word, line or paragraph under editing scrutiny.

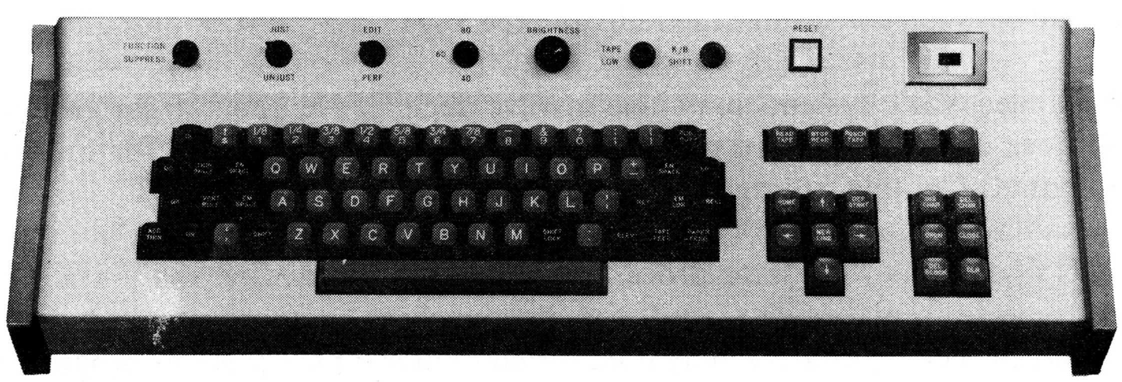
VDTs incorporate standard typewriter (QWERTY) sets of keys with two extra sets: one for editing and one for typesetting functions.

Here is a list of the editing and function controls and what they do for one specific VDT. This list is by no means inclusive, and presented only to orient you to the kinds of command keys available on VDTs.

CONTROL or INDICATOR	*FUNCTION*
FUNCTION SUPPRESS Switch	Toggle switch. In up (Suppress) position inhibits display of function symbols on screen, but does not delete them from memory. In down (Normal) position, allows function symbols to be displayed.
JUST/UNJUST Switch	Toggle switch. In JUST position, causes Elevate code read from tape or keyboard to move cursor to new line. In UNJUST position, Elevate codes are displayed and punched, but are not executed.
EDIT/PERF Switch	Toggle switch. In EDIT position, all functions are active. In PERF position, characters typed on the keyboard are punched one by one. The screen and tape reader are disabled.
BRIGHTNESS Potentiometer	Controls brightness of characters displayed on screen. Rotate clockwise to increase brightness, counterclockwise to decrease brightness.
TAPE LOW Lamp	Lamps lights when tape-out switch on punch tension plate opens, indicating that only a few inches of blank tape remain. Punch is disabled, but unpunched text remains intact in punch buffer. By setting EDIT/PERF switch to PERF, leader codes may be punched before loading new spool of tape.
K/B SHIFT Lamp	Lights whenever machine enters shifted mode; goes out when machine returns to unshifted mode.
RESET Switch	Pushbutton switch. When pressed, erases entire screen, drives cursor to Home position, sets unshifted mode, and initializes reader and punch interface.
QL Key	Displays Quad Left symbol and drives cursor to start of new line.
QC Key	Displays Quad Center symbol and drives cursor to start of new line.
QR Key	Displays Quad Right symbol and drives cursor to start of new line.
UR Key	Displays Upper Rail symbol.

RUBOUT Key	Displays Rubout symbol.
LR Key	Displays Lower Rail symbol.
RET Key	Displays Return symbol.
BELL Key	Displays two separate symbols for shifted and unshifted modes.
SHIFT LOCK Key	Alternate action key; if machine is in unshifted mode, SHIFT LOCK sets shifted mode and lights K/B SHIFT lamp; if machine is in shifted mode, SHIFT LOCK sets unshifted mode and extinguishes K/B SHIFT lamp.
ELEV Key	Displays Elevate symbol. In JUST mode only, drives cursor to start of new line.
TAPE FEED Key	Displays Tape Feed symbol; has no immediate effect on punch.
HOME	Drives cursor to Home position (top left corner of (screen).
(Cursor Up) Key	Drives cursor up one line for each pressure. Inhibited if cursor is already in top line.
DEF START Key	When pressed, current cursor position is defined as start of punch or delete block operation. Cursor must then be moved to indicate end of operation.
(Cursor Left) Key	Drives cursor one character position left for each pressure. Inhibited if cursor is already in leftmost position of line or column.
NEW LINE Key	Drives cursor to start of next line.
(Cursor Right) Key	Drives cursor one character position right for each pressure. Inhibited when cursor reaches end of screen.
(Cursor Down) Key	Drives cursor down one line for each pressure. Inhibited when cursor reaches bottom line.
READ TAPE Key	Starts tape reader. Reader stops automatically after approximately 1600 characters have been read and displayed at 50 cps. rate. After the halt, reading may be continued by pressing READ TAPE key for each character or by holding key down to read at Repeat rate of 15 cps.
STOP READ Key	Halts automatic reading at any time. In automatic read area of screen, may be held down while READ TAPE key is pressed to read single characters.

PUNCH TAPE KEY	When pressed, a block of text is transferred to the punch buffer and punched. The start of the block is defined by the cursor position at the time the DEF START key is pressed; if no start position is defined, punching starts from the Home position. The end of the block is the character to the left of the cursor position at the time PUNCH TAPE is pressed.
INS CHAR Key	The character at the cursor position and all characters to the right of it are moved one position right; a null is inserted at the cursor position. The function is inhibited if the shift would move any character except a space into the last position of the line.
DEL CHAR Key	The character at the cursor position and all characters to the right of the cursor are moved one position left. A null is inserted in the last position of the line.
OPEN Key	All characters from the cursor position to the end of text are recopied starting at the end of screen and building up.
CLOSE Key	Material at the bottom of the screen is recopied, starting at the cursor position. This closes any gap left after insertion of new material; the wraparound feature prevents the breaking of words at line endings.
DEL BLOCK Key	Erases all characters between a previously defined Start (or the Home position if no Start was defined) and the current cursor position. The gap is closed.
CLR Key	Erases all characters from the current cursor position to end of screen. Nulls are inserted in the erased positions.



A full view of the CorRecTerm keyboard. There are three basic, if undemarcated areas: typewriter character set, typesetter function set and display control set.

Editing

When a character or group of characters is presented on the screen, certain editing functions are possible, more or less dependent upon the particular VDT. Most errors involve single characters, and these are corrected by positioning the cursor at the character position involved and depressing the correct character key. This erases the incorrect character and replaces it. The technique is called "writing over." On some units it may be necessary to first strike a DELETE key to erase the incorrect character, hit an INSERT key and then the correct character. Writing over is much simpler.

Characters are either inserted, deleted or changed. So are lines and paragraphs. Thus editing keys may be provided to perform each of these functions. In all these operations the cursor is used to define the data to be operated on. Positioned at the beginning of the word or paragraph, new data may be inserted or removed. When deleted, most units automatically close up the resultant space by moving all characters to the right of the "hole" *left* to fill it up. Insertion of characters moves all data ***right*** to make room. An important function of VDTs is the ability to "wraparound"; that is, take words that will not fit on a line and move them to the beginning of the next line and so on until the end is reached.

The operator has now input all data, modified it through changes, additions and deletions and is now ready to be output in the form of tape or direct impulses to a photo unit.

Stand-alone units

Take one VDT "tube," put a reader on one side and a punch on the otherand you have a stand-alone unit. You can read in tapes produced on other keyboards, or type in information from the keyboard. The resulting data may be reviewed and edited and then output via the punch to produce a new tape.

Expanded systems

If a great deal of data will be edited, a magnetic disc or drum or tape cassette may be used to store all characters before and after their screen debut. Normally a "controller" which is often a mini-computer directs character traffic between the storage medium and the VDT.

Expanded VDT systems may also involve dependence upon larger general-purpose computers. Here much greater capability is available for massive amounts of editing, storage and retrieval.

VDTs began as what data processing folks call "data windows." The first units were replacements, not for keypunches or typewriters, but for teletypes. Teletypes are widely used for computer input. Systems progressed and were tied into computers for reservations, credit checking and inventory control. The late, great company called Viatron attempted to create a unit that would pre-process data prior to computer input. The year Viatron bit the dust over forty-five VDTs were exhibited at the Spring Joint Computer Conference. Many more were certainly in the wings.

It was a little under three years ago when the first VDTs were shown to anxiously - waiting newspapers at the ANPA/RI exhibit in Chicago (1969). It has taken some time but we are just getting started.

The Hendrix 5700 video display.

Some important points:

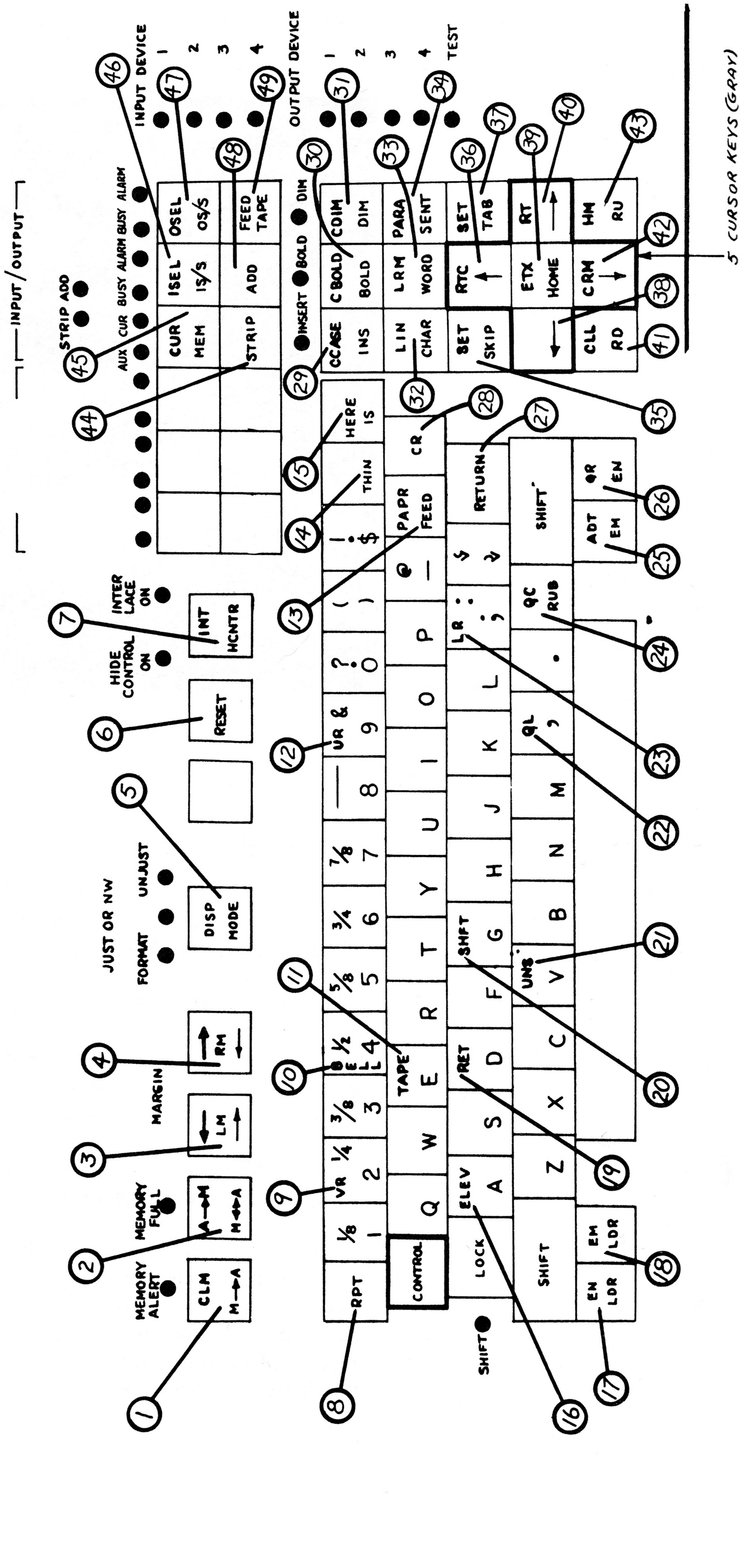
The size of the screen is important. Both for the amount of data to be handled at one gulp and to the clarity and size of characters. VDTs are a visual medium, and like television, can contribute to eye fatigue. One of the larger units today has an 18 inch (diagonal) screen that displays 30 lines of 90 characters. About 2,000 characters is the average.

Erasing the screen gets rid of material which is no longer needed. Used carelessly, it will also get rid of material which is needed. Character, Cursor-to-end-of-line, and Line Delete functions handle short erasures.

Scrolling may vary from simple movement of displayed material upward, off the top of the screen both upward and downward movement.

Scrolling depends largely upon the relationship between the VDT's refresh logic and its screen complement. When memory capacity equals the number of characters which can be displayed, memory content is exactly the same as the display. Blanks are stored in memory for all unused positions on the screen. More sophisticated units are designed so that only the characters which are displayed take up space in the refresh memory.

Here is the keyboard arrangement of one VDT system presently on the market. Note the extensive editing capabilities available.



1. CLEAR MEMORY (MAIN)
   COPY MAIN INTO AUXILIARY

2. COPY AUXILIARY INTO MAIN
   SWAP MAIN AND AUXILIARY

3. LEFT MARGIN CONTROL

4. RIGHT MARGIN CONTROL

5. DISPLAY MODE SELECTOR

6. RESET SYSTEM LOGIC

7. INTERLACE ON/OFF
   HIDE CONTROL CODES ON/OFF

8. REPEAT

9. VERTICAL RULE

10. BELL CODE

11. TAPE FEED

12. UPPER RAIL

13. PAPER FEED

14. THIN SPACE

15. HERE IS MULTIPLE CODES

16. ELEVATE

17. EN LEADER

18. EM LEADER

19. RETURN

20. SHIFT

21. UNSHIFT

22. QUAD LEFT

23. LOWER RAIL

24. QUAD CENTER
    RUB OUT

25. ADD THIN SPACE
    EM SPACE

26. QUAD RIGHT
    EN SPACE

27. RETURN CURSOR (entry)

28. CURSOR RETURN (editing)

29. CHANGE CASE
    INSERT MODE SELECTOR

30. CHANGE BOLD
    BOLD SELECTOR

31. CHANGE DIM
    DIM SELECTOR

32. LINE INSERT
    CHARACTER REMOVE

33. LINE REMOVE
    WORD REMOVE

34. PARAGRAPH REMOVE
    SENTENCE REMOVE

35. SET/SKIP

36. REMOVE TO CURSOR
    CURSOR UP

37. SET/TAB

38. CURSOR LEFT

39. END OF TEXT (ETX)
    HOME CURSOR

40. CURSOR EXTREME RIGHT
    CURSOR STEP RIGHT

41. CLEAR LINE
    ROLL DOWN

42. CLEAR REST OF MEMORY
    CURSOR DOWN

43. HOME MEMORY
    ROLL UP

44. STRIP OPTION SELECTOR

45. CURSOR I/O SELECTOR
    MEMORY OUTPUT SELECTOR

46. INPUT DEVICE SELECTOR
    INPUT START/STOP

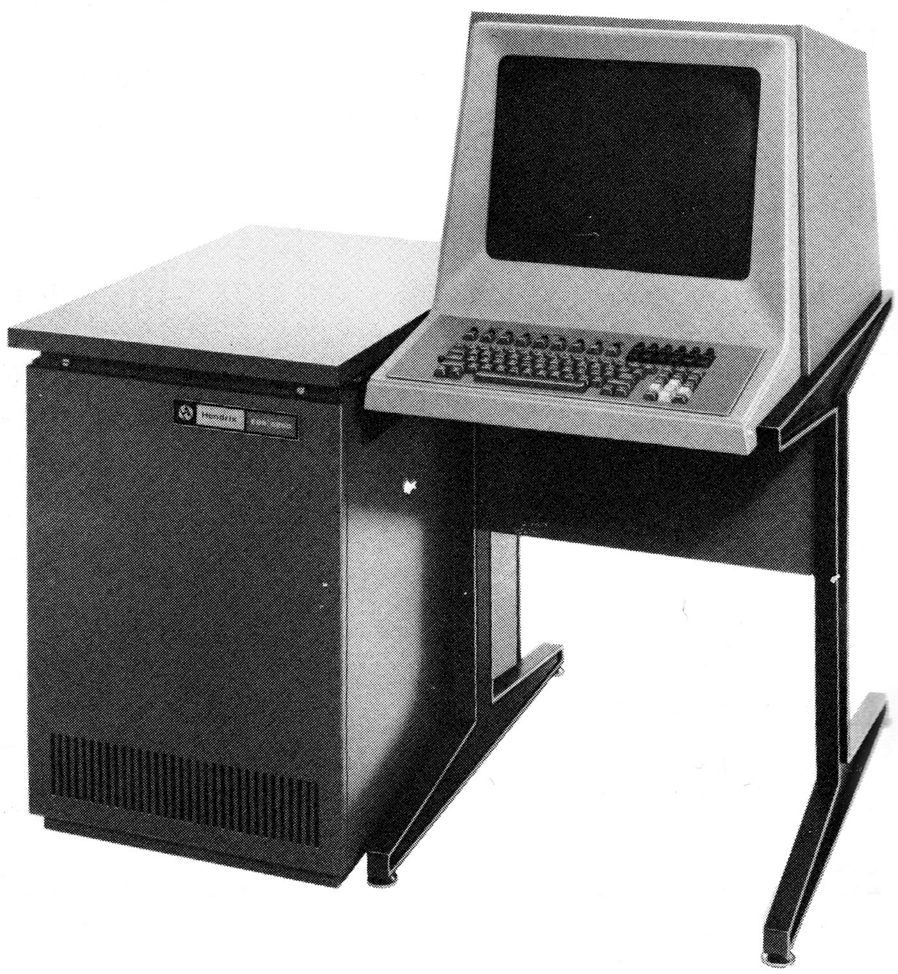
47. OUTPUT DEVICE SELECTOR
    OUTPUT START/STOP

48. ADD OPTION SELECTOR

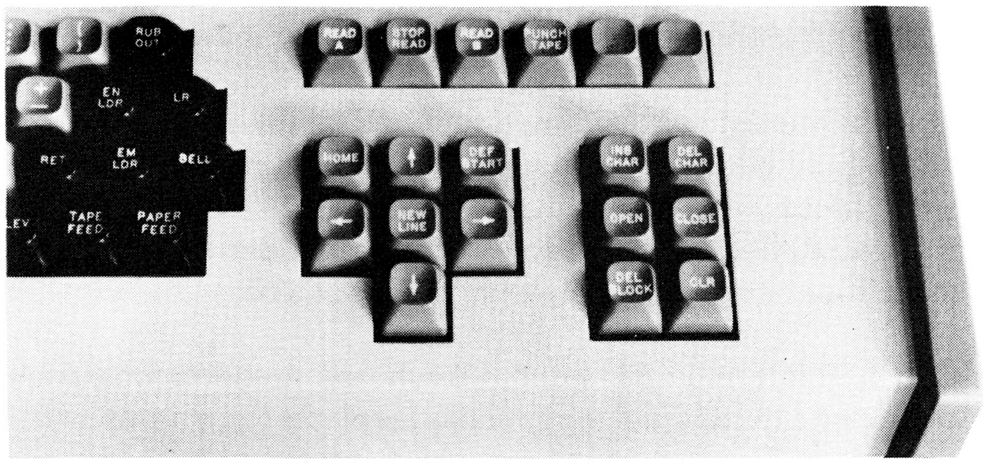
49. FEED TAPE SPACING

Some VDT's do not display some typographical characters and commands. Here are some of those symbols displayed by one VDT system.

Quad Right (QR)	→
Quad Center (QC)	↔
Quad Left (QL)	←
Upper Rail (UR)	↑
Lower Rail (LR)	↓
Em Space (EM)	
En Space (EN)	▯
Em Leader (EM LDR)	••
En Leader (EN LDR)	•
Vertical Rule (VR)	❙
Tape Feed (TAPE)	TF
Paper Feed (PAPR FEED)	PF
Return (RWT)	
Elevate (ELEV)	
Shift (SHFT)	**T**
Unshift (UNS)	⊥
Thin Space (THIN)	‖
Add Thin Space (ADT)	|||
Bell (BELL)	
Rub Out (RUB)	⁞⁞⁞


The Hendrix 5200 video display.

Here are the control keys of the Mergenthaler CorRecTerm video display terminal. The cluster of keys at right controls editing functions; that at left controls cursor position; and that above controls input and output.



Control of a VDT

The cursor, displayed by alternating the background of a character between black on white (BOW) and white on black (WOB), indicates the position on the screen at which a function is to be performed. It blinks to take the operator's attention to that point on the screen. A character entered from the keyboard appears on the screen exactly where the cursor is currently located, then the cursor automatically moves to the next character position.

Return Designed to be used for ***test entry*** and its function depends on which mode is operating, as follows:

FORMAT MODE — RETURN is used to return the cursor to the beginning of the next line on the display.

JUST or NW MODE — RETURN inserts customer specified line delimiter at the end of a line and moves the cursor to the beginning of the next line.

UNJUST MODE — RETURN inserts customer specified paragraph delimiter at the end of a paragraph and moves the cursor to the beginning of the next line. In this mode, all cursor-returns at the end of lines are done automatically.

CR (CURSOR RETURN) — Moves the cursor to the beginning of the next line. CR was designed to be used for ***text editing*** and to be independent of the mode of operation.

HOME — Moves the cursor to the upper left-hand corner position on the screen called "Home."

By depressing any one of the arrow keys, the cursor is moved one position at a time in the direction of the arrow and will repeat in that direction when held down.

END OF TEXT — Moves the cursor to the exact end of text which is defined as the point where the operator can start entering new characters in order to append previously entered text. If the end of text position is not on screen, ROLL-UP'S will be automatically generated to bring it into view where the ETX function can be performed.

RIGHT — Moves the cursor to the right side of the line the cursor is located in.

Editing

Many advanced editing controls are often provided so that the operator can rapidly and effectively edit text. For the convenience of the operator and to help speed up the editing process, a WORD, SENTENCE or PARAGRAPH can be removed in their entirety with just a few key strokes, in addition to removing single characters at a time.

OVERSTRIKE is the normal keyboard mode of operation where each character entered from the keyboard replaces the character in the location of the cursor. The cursor will step right and no other character on the screen will be disturbed.

The operator should select the INSERT mode (INSERT light ON) when he desires to insert a missing character between two characters. A character entered in this mode is inserted at the position of the cursor, pushing the character previously there to the right one position.

The keyboard is automatically switched from the INSERT mode to the OVERSTRIKE mode when the cursor is moved by any of the cursor control keys.

CHAR (CHARACTER) removes the character in the cursor position, closing text up. Keeping CHAR depressed continuously removes characters by pulling text in from the remainder of the line.

CCASE (CHANGE CASE) changes the case of the character under the cursor from upper case (A,B,C) to lower case (a,b,c) or vice versa. Especially helpful when an input tape has missing unshift or shift codes.

BOLD displays characters as they are entered from the keyboard as black on white background instead of the normal white on black. BOLD keyboard entry (BOLD light ON), is useful when an operator wishes to distinguish bold face characters from the remaining text. This saves the operator from having to enter upper and lower rail codes.

CBOLD (CHANGE BOLD) reverses the display of the character under the cursor from NORMAL to BOLD or from BOLD to NORMAL, depending on the initial state of the character. Useful for going back over text and changing characters to or from BOLD face.

DIM displays characters entered from the keyboard as either: gray characters on black background for DIM/NORMAL ENTRY (DIM light ON only); or the reverse, displayed as black characters on a gray background for both DIM/BOLD entry (DIM and BOLD lights ON). Useful to distinguish italic or other type characters from the rest of the displayed text.

CDIM (CHANGE DIM) reverses the display of the character under the cursor from either: NORMAL to DIM/NORMAL or DIM/NORMAL to NORMAL; or from BOLD to DIM/BOLD or DIM/BOLD to BOLD. Useful for going back over text and changing NORMAL and BOLD characters to or from their DIM configurations.

WORD removes the word in which the cursor is located, closing text up.

SENT (SENTENCE) removes the sentence containing the cursor, closing text up.

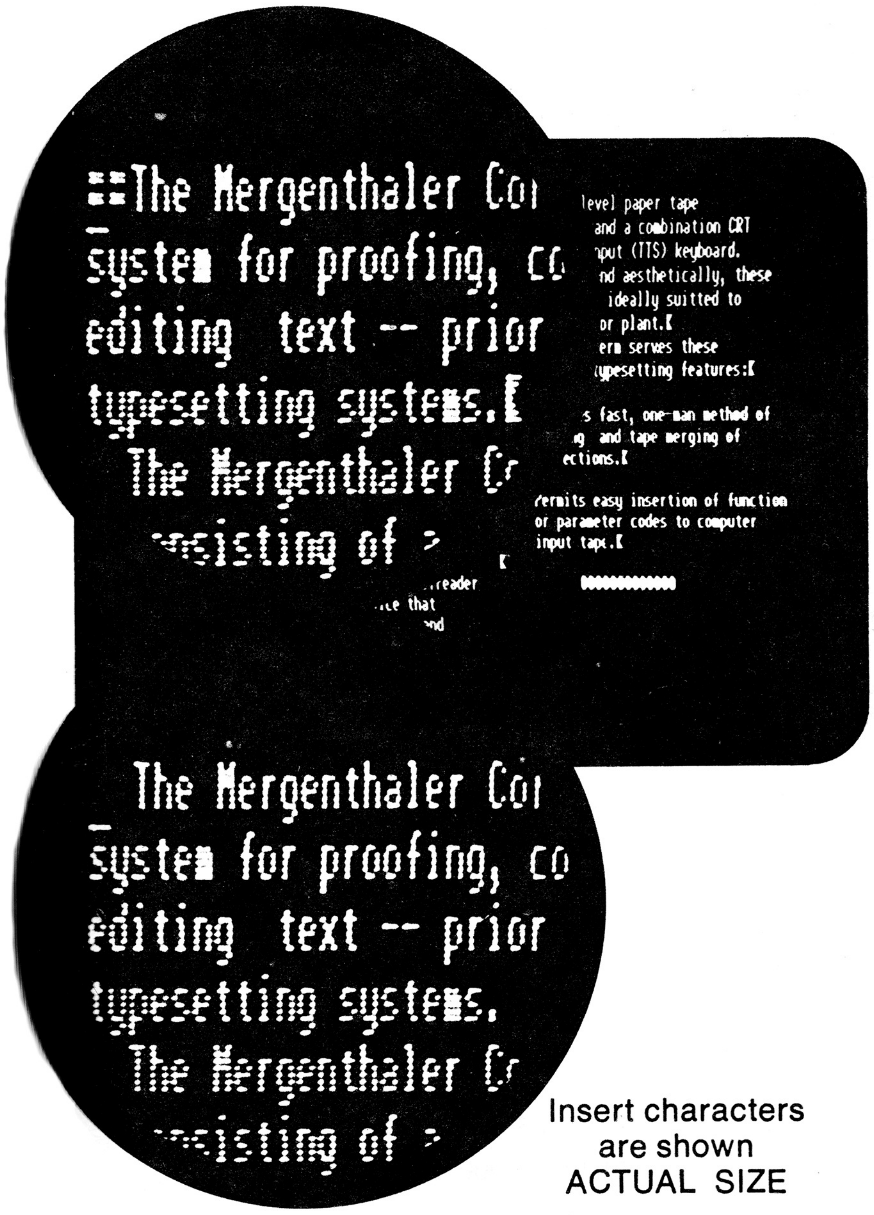
PARA (PARAGRAPH) removes the paragraph containing the cursor, closing text up.

LIN (LINE INSERT) moves all text from the line the cursor is located in down one line, leaving a blank line.

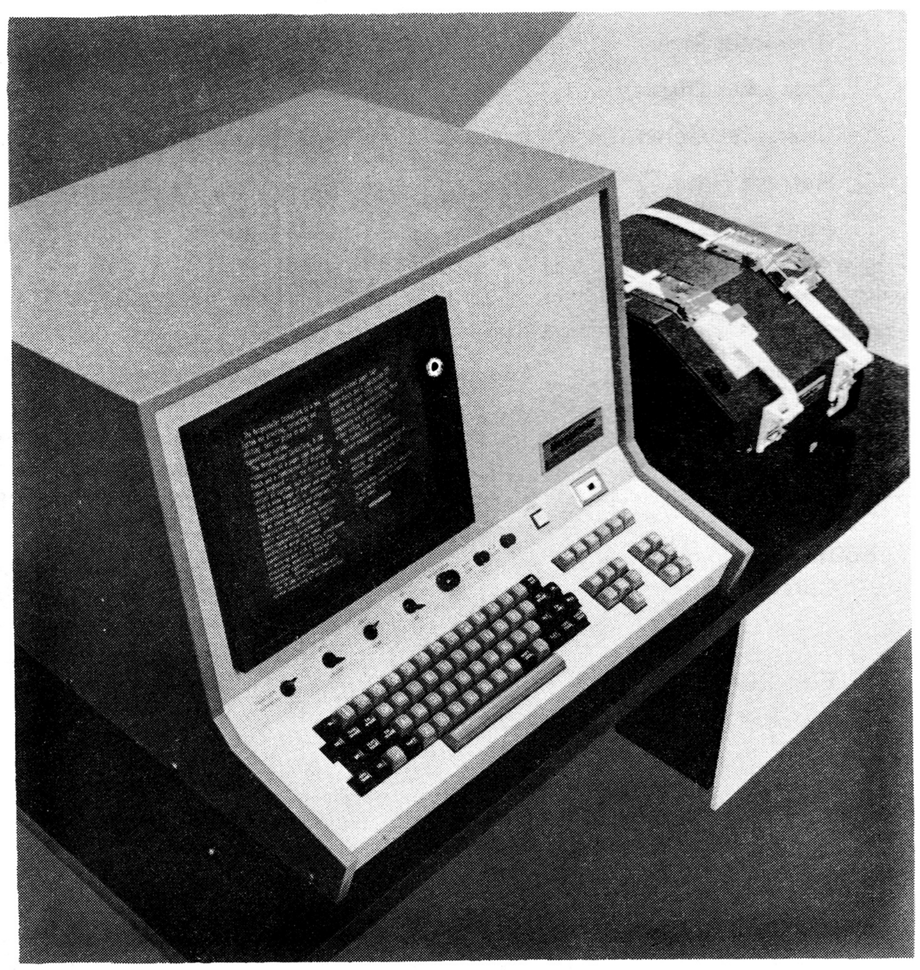
LRM (LINE REMOVE) removes the line containing the cursor, moving the remaining text on the screen up one line to fill the space.

CLL (CLEARLINE) erases the line containing the cursor, leaving a blank line in its place.

Rolls text on the screen up one line at a time "forward" through main memory, until it stops at the bottom of memory. RU can be *Roll up, Roll Down* the beginning of the story. Rolls text on the screen down one line at a time "backward" through main memory, until it stops at the top of memory.



Insert characters are shown ACTUAL SIZE



The Mergenthaler CorRecTerm. The unit at right reads in tapes and perforates new ones.

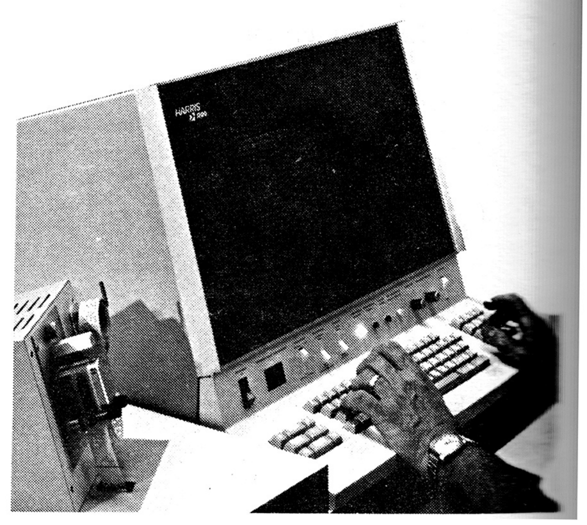
Equipment and Model Nomenclature	CO:75 Multi-Station Communications	Harris 1100 Editing & Proofing
Base Price	–	$14,500.00
Lease Available?	Yes	Yes
Input		
Source	Manual Input from Operator via Keyboard; Remote or Local Computer, Photo-composition or Automated Typesetting System	Paper Tape, OCR Scanner (Option), Computer, Magnetic Tape (Option)
I/O Interface	Varies – Would Depend Upon the System or Computer the CO:75 is Communicating with. Many Standard Interfaces are Available	–
Input Rate	A Function of the Input Source; Parallel Input Rate Up to 250,000 CPS	120 – 960 CPS
Output		
Source	Printer, CO:75 Display, Output May be End Product of a Photo-Composition or Automated Type Setting System	Paper Tape, Computer, Magnetic Tape (Option)
Output Rate	A Function of Output Source; Parallel Output Rate Up to 250,000 CPS	75 CPS – 960 CPS
Display		
Tube Size	14" Rectangular	8½" High, 11" Wide
Character Size	0.100" x 0.80"	14 Point
Character Display	–	158 Different Characters
Character Generation	TV Raster Scan	Modified Stroke, 165 Elements
Refresh Rate	60 Hz (50 Hz Optional)	60 Hz (Synchronized)
Font	IBM Courier	Cairo Light and Bold
Format	The User has a Choice of 9 Screen Formats	50 Lines of Up to 40 Characters and 25 Lines of Up to 80 Characters
Capacity	3000 Characters Maximum	2000 on Screen, 6000 in Memory
Keyboard	Similar to a Standard Typewriter, but Cursor Controls and Other Special Function Items, Including Editing	Any Arrangement
Editing		
Cursor	The CO: 75 Control Unit Supports a Broad Range of Editing and Cursor Control Functions	Solid, Up, Down, Left, Right, Next Line, Home
Edit Functions		Insert, Delete, Overstrike, Paragraphing, Move, Bold Face, Display Ad Mode
Control Functions	–	Focus, Brightness, Wire Strip, Ad Display
Memory	Delay Line	2000 to 6000 Continuous
Circuitry	–	Solid State
Environment	60 – 90°F/10 – 90°R.H.	40° to 100°F; No A/C Required

Equipment and Model Nomenclature	IMLAC Composer-15	Videotype
Base Price	$16,850.00	$16,000.00
Lease Available?	Yes	60 Months at $375.00 per Month (Includes Service)
Input		
Source	Paper Tape - Standard; Magnetic Tape — Optional; Communications Interface, Others	N/A
I/O Interface	—	N/A
Input Rate	300 CPS; Paper Tape; Others to 2000 CPS	—
Output		
Source	Paper Tape — Standard; Magnetic Tape — Optional, Others	Hermes Varia and IBM Selectric
Output Rate	110 CPS; Paper Tape; Others to 2000 CPS	14 Characters/Second
Display		
Tube Size	15″, 17″ or 21″ Diameter	Exact Size of 8½ x 11″ Sheet of Paper
Character Size	Multiple Sizes	10 Point Upper & Lower Case
Character Display	Proportional Space	N/A
Character Generation	Stroke	N/A
Refresh Rate	40 Frames Per Second	N/A
Font	Upper, Lower Case, Bold, Roman	Proportional Spacing
Format	Fully Justified, Quad Right etc., On Command	7,000 Character
Capacity	1000 Characters Displayed — Approximately 400 Characters Stored	Standard Electric Typewriter Keyboard
Keyboard	Yes	Yes
Editing		
Cursor	Up, Down, Right, Left-Single Step or Continuous	—
Edit Functions	Insert, Replace, Delete, Text Transposing, Others	Add, Delete (Character), Erase, Line Add, Line Delete, Edit, Merge, Justify
Control Functions	Over 50, Write for Brochure	Operates Like a Selectric Typewriter
Memory	8K Core Memory	N/A
Circuitry	Solid State Integrated Circuit	N/A
Environment	Office or Plant	Office — Secretarial

Hendrix EDS 5200 Terminal	Hendrix EDS 5700 Controller EDS 5700 Terminals
$12,900.00	Controller: $19,000.00 Terminals: each $3,900.00
Yes	Yes
Paper Tape (6 – Adv 8-in. Line), News Wire (Current Loop), OCR's, Computer, Dataset	Paper Tape, Mag Tape, Tape Cassettes, OCR, Computers, News Wires
Readers, Punches, News Wire, CX Reader, 2961 HS, 4961, 713, Pacesetter, ACM 9000, (1130), RS 232 – CUSTOM	Serial RS232, Current Loop, Parallel Burst Rate Up to 100 KC
Up to 240,000 Words/Second	Up to 100,000 Words/Second
Paper Tape, Direct to Photo-Typesetters, News Wire, Dataset, Computers	Paper Tape, Mag Tape, Tape Cassettes, Computers, Phototypesetters, News Wires
Up to 240,000 CPS	Up to 100,000 Words/Second
17" Diagonal	12" Diagonal
20 Point	20 Point
Dot Raster	Dot Raster
Dot Raster Field 9 x 13	7 x 11 Matrix
Dot Raster Field 9 x 13	60 CPS
4 Fonts Available – Standard TTS or ASCII Optional Custom (128 Characters) Operator Selectable from 16 x 32 to 96 x 32	Standard – TTS or ASCII. Optional: Custom (128 Characters) 72 x 18 standard Optional: 80 x 18
Screen Capacity Variable Up to 3,072	1296 Characters
51 or 64 Character Plus Editing, Total 106 Keys	106 Keys
Next Line, End of Text, Up, Down Left, Right, Home Set/Skip	Up, Down, Left, Right, Home Diagonals
Change Case, Insert (Manually or on Input), MOve Block, HOme Memory, Cancel Line, Line Remove, Overstrike, Character Remove, Word Remove, Sentence Remove, Paragraph Remove, Roll Memory Up, Roll Memory Down, Remove Text to Cursor, Set/Skip, Cursor Step and Home (5 Keys), Clear Rest of Memory, End of Text, Set/Tab Auto Bold, Verify	Change Case, Insert, Home Memory, Cancel Line, Line Remove, Overstrike, Character Remove, Word Remove, Sentence Remove, Paragraph Remove, Roll Memory Up, Roll Memory Down Remove Text to Cursor, Set/Skip, Cursor Step and Home (5 Keys), Clear Rest of Memory, End of Text, Set/Tab, Auto Bold, Verify
Justify and Unjustified	Justify Display, Unjustify Display
MOS-LSI Memory Up to 8K	MOS-LSI, RAM
TTL Solid State	TTL – (50% MSI-LSI)
40^{o} to 90^{o}F, 10% to 90% Relative Humidity. All Cooling Air is Filtered to Provide Contamination Protection from Dust and Other Particulate Matter	0 – 50^{o}C 90% H W/O Cond.

Hendrix
EDS 5200 TERMINAL

Hendrix EDS 5700



HARRIS 1100

Mergenthaler CorRecTerm* M/100	Mohrtext 1200 Editing-Proofing Terminal
$9,750.00	$5,700.00
Yes	Yes
Justified and Unjustified Paper Tape, Wire Service Tape	6 or 8 Level Local Unjustified Paper Tape Wire Service Paper Tape, Keyboard, OCR Copy, PDP-8 Typesetting System Output
Paper Tape Reader	PDP-8 Typesetting System
50 CPS	Paper Tape Reader: 150 Characters/Second; Keyboard: Up to 500 Characters/Second Bursts (See "Keyboard" Entry Below); OCR Reader: 60 Characters/Second; PDP-8 Typesetting System Output: 180 Characters/ Second (Approximately)
Paper Tape Punch	Paper Tape Punch, PDP-8 Typesetting System Reader Input
50 CPS	Punch: 75 Characters/Second; PDP-8 Typesetting System Reader Rate: 110 Characters/Second (Approximately)
12" Diagonal	14" Diagonal
14 Point	12 Point Nominal
5" x 7" Dot Matrix	Monospaced P-38 Green Phosphor.
TV Compatible	7 x 15 Dot Matrix
60 Hz, Flicker Free	30 Hz Interlace (Flicker Free)
Upper & Lower Case	Upper & Lower Case Alphanumerics, Full Punctuation, Special TTS Symbols, Full 127 Character Set (104 Characters Standard, Expandable to 127), Generated on 7 x 15 Dot Matrix
24 Lines at 80 Characters, Single Column 24 Lines at 60 Characters, Single Column 48 Lines at 40 Characters, Double Column 24 Lines at 80 Characters, Line by Line	Single Column: 32 Lines of 80 Characters Maximum per Line, with Full Word Wrap-Around
Light Touch Electronic — 64 Key TTS, Secretarial or TTS Shift	32 Lines of 80 Characters per Line for Total of 2,560 Characters
Light Touch Electronic 64 Key TTS, Secretarial or TTS Shift	Light Touch, N-key Rollover, Electronic Encoded, 65 Key with Shift, Shift Lock, and Backspace. N-key Rollover Permits Burst Operation Without Loss of Key Strokes
Non-destructive Underline: Up, Down, Right, Left, (Single Step or Continuous), Home and New Line	Selectable by Operator from 7 Types: Underline, Blink, Non-blink; Background, Blink, Non-blink; Full 80 Char. Underline with Any of Above Except Non-blink Underline Cursor. Cursor Operations Include: Up, Down, Left, Right and Diagonal Home (First Char. on Screen), End (Last Character on Screen), Tab and Next Line
Insert, Delete or Overstrike of Characters, Lines or Blocks	Insert, Delete, Move, Replace and Backspace
Function Suppress: Justified or Unjustified; Edit or Perforate; Keyboard Control of all Input/Output Functions	Single Line or Continuous Up/Down Through Up to 10,240 Characters, Vertical Tabbing (Half Screen at a Time), Scroll Home and Scroll End
3840 Characters; Fully Buffered	64 Lines of 80 Characters Each are Standard Up to a Maximum of 128 Lines for a Total of 10,240 Characters Maximum
I/C Logic Circuits, Solid State	All Solid State Integrated Circuitry Computer Controlled Logic Unit
No Special Requirements	No Special Temperature and Humidity Requirements Needed

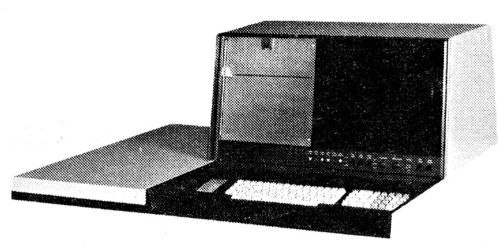
* An optional unit, designated M/101 has two input readers for tape merging capabilities (See attached brochure).

IMLAC COMPOSER-15

VIDEOTYPE

MERGENTHALER CORRECTERM M/100

MOHRTEXT
1200 EDITING-PROOFING TERMINAL



7. Optical character recognition (OCR) systems

Before the typesetting and printing process can begin, manuscript material must be converted. This conversion process embraces two very important functions:

- -it converts the material to a form compatible to the typesetter being used. In practice, this usually means the creation of a punched paper tape in the appropriate 6 level TTS format.

- -it adds the typesetter control instructions, so that the finished textual material is of the desired format, and appears in the right font and size.

There are conversion processes that accomplish both steps by a single conversion operation, while other processes require two separate steps to be taken.

The actual choice of the conversion process will depend to a great degree on the form of the manuscript, or document. Where the manuscript is in the form of a typed page, it may be possible to read by pages directly by using an OCR system. Or, the pages may be converted to tape by using keyboard devices. Where the manuscript is in the form of machine readable tape, it may be possible to use this tape to create useful typesetter input.

this technology has the ability to take typewritten sheets and scan them to produce a recorded medium such as tape. Why developed?

Extracting information from a document falls under the general heading of character recognition. This idea was first developed by the data processing world in an attempt to eliminate the input conversion step. It was found that many documents were generated by a machine to impart information to a human, and that this same information was subsequently required by a machine. A primary example of this problem is the utility bill or credit card bill. A slightly different problem exists where it is necessary to give unique identity to a document, such as a check. In all these cases, the general principles of character recognition were promoted so that it was not necessary to use a keypunch operation to get this material back into machine readable form. As the volume of such keypunching increased, the value of character recognition equipment also increased.

A number of machines are now available to address certain specific tasks, such as reading journal tapes from adding machines, reading sales slips

embossed by credit cards, reading hand marked test scores, and so on. A number of these machines have important constraints on the number of characters they can recognize, the type of material upon which the characters are printed, the size of the document they can accept, etc.

In general, two basic recognition schemes are being used today (1) reading the character by magnetic means, or (2) reading the character by optical means.

The most widely used magnetic method of character recognition is called MICR (Magnetic Ink Character Recognition). In this scheme, the characters are printed using special magnetic ink. The characters, due to their distinctive shape, have unique magnetic properties, and it is possible to read these characters by using a special magnetic reader. The character set is limited, consisting only of the numbers 0-9 plus 4 special characters.

The banks are the largest users of this concept. Printed checks usually contain the name of the account holder (be it an individual or a company) and the account number using MICR characters. In this way, the check can be machine read to establish the account number.

The associated code is a machine readable code associated with a human readable character. In this way, the information is conveyed to the human reader by conventional characters, while the machine reads the associated code. A great deal could be said about the applications of the different techniques, but our primary purpose is to simply expose the concept.

Datatype uses an IBM Selectric typewriter equipped with a special ball. It is also possible to modify a line printer to produce this font, but the primary value of the idea is the ability to use a standard office typewriter as a data recorder. Once the page is produced using the Datatype code, it can be read by a special page reader made by Datatype. The reader scans the page, a line at a time, and converts the information to a punched tape or magnetic tape. The machine readable code located under the human readable character is similar in principle to the Semagraph, and shares the drawback of being limited in the number of codes available. Datatype can print 88 codes, and since some of these codes are related to control, they do not print a human readable character. This has the effect of reducing the character set of the typewriter. The Datatype page reader is in the $10,000 class, and the reader is used in conjunction with a minicomputer and tape punch or mag tape drive to form the entire system.

The Potter approach uses bits printed both above and below the human readable characters. Potter has based the system on the use of cards, which can be printed by means of a special typewriter (either Selectric or type bar) or a special line printer. The value of the system seems to be in the ability to sort and collate cards. The card reader is available with interfaces to permit connection directly to a computer, thus the need to convert to a tape is eliminated. The reader is rather expensive, being in the $20,000 range. The character set is limited to 64 codes.

Dual Image uses a full 8 bit code pattern printed below the human readable character. The images are generated by a special printer, which can print a character set of 128 different symbols. In addition, the 8 bit code pattern can furnish any of the 256 different possible codes. The printer can also produce two character mnemonics using a single character space. The printer produces a strip of tape, which is then read by a very simple reader in the $1,000 price range. Interfaces are available to connect directly to computers, so there is no need to convert to a different machine readable media. The use of 8 bits in the code pattern also permits the printed code to be in machine compatible format, so that no code conversion is required.

Mark Sense requires the use of a special mark placed in a particular zone on the document. The mark is usually made by a soft lead pencil, and the reader merely determines the absence of or presence of this mark. The concept is widely used in scoring tests, where the answer may be "true or false" or possibly one choice in five. The business world uses a similar scheme, but it is based on a numeric only technique where the mark is placed in a one out of 10 basis. Mark sense readers are marketed by IBM, NCR, and Hewlett-Packard (to name a few) and start as low as $3000.

OCR, itself, recognizes the character by its shape, similar to the way the human eye reads. OCR readers are classified by their ability to read different font styles or character shapes (single or multifont), and by the number of different characters that can be recognized (sometimes referred to as the "vocabulary" of the reader).

Single font readers are manufactured to read a specific font style, such as the USASI OCR-A font, or the European ISO OCR-B font.

Since these fonts are stylized, they must be generated by typewriters or line printers that are so equipped. In general, the spacing between characters, the spacing between lines, and the reference to a given side of the page must be rather precise. OCR readers are frequently sensitive to paper material, since the "reflectivity" of the paper vs the reflectivity of the image must be consistent.

Multi font readers have the ability to be programmed to read any number of different font styles. They usually have a fairly large vocabulary, and can read upper and lower case characters, the number set, punctuation marks, plus some special characters. Some machines can even read carefully executed handwriting. In the main, these machines can accept material that has been produced on standard office typewriters or line printers. Obviously the more capability of the machine the higher its cost, and large vocabulary-multi font readers are very expensive.

As with single font OCR readers, the multi font system reads the input page and produces a machine readable tape, either magnetic or paper. Since a computer is included as an integral part of the system, it is possible to do some formatting of the output material. The nature of the formatting, and its extent, is a function of the computer program.

Document readers can generally read one-to-five lines of information from a paper coupon, stub card, or similar document. Most document readers can handle documents ranging in size from 2 x 4 inches to about 4 x 8 inches.

Document readers are widely used in reading turn-around forms such as statement remittance stubs where the printed output from a computer later becomes input to the computer.

Page readers are generally designed to read large and variable amounts of alphanumeric information typed or printed in normal page format. Most page readers accept sheets from 8½ x 11 to 12 x 14 inches in size. Page readers also have the capability of reading somewhat smaller sheets and continuous fan-fold or rolled sheets printed by computers or by specially equipped typewriters.

Bar-code readers sense marks that are used in combinatorial form to indicate data. The type of marks used varies, but in most cases the marks cannot be formed by hand and are not easily readable by humans.

Usually, special devices are required to produce the bar code imprinting. Bar codes also suffer because the code and the character occupy a good deal of space.

Character readers are the upper-class of optical readers. They translate human-readable characters into machine-readable form. Many specialized fonts have been developed to simplify the character recognition logic and hence lower the price.

A ***document reader*** reads documents of less than standard letter size (8.5 x 11 inches). A ***page reader*** reads at least letter-size documents and usually larger ones. Another way of distinguishing between document and page readers is that document readers generally read one or two lines per document, while page readers can read many lines from each document. ***Single font*** means that the reader can be equipped to read one typeface only. ***Multiple font*** means that the reader can be equipped to read several typefaces but only one at a time; switching between type faces can be a manual or programmed feature. ***Multi-font*** means that the reader can read multiple typefaces intermixed; this is the most sophisticated and expensive type of optical reader. ***Journal tape*** is the rolls of tape used by adding machines and cash registers.

Now that we have defined the types of devices we're talking about, let's discuss their application.

Who Uses Optical Readers?

Mark readers are used principally for data collection and for entry of limited amounts of data on previously punched cards.

Bar-code readers and character readers have many applications. The principal ones at present are the reading of slips imprinted with a credit card, processing of turnaround documents, and sorting of the U.S. Mail.

Various manufacturers estimate that any installation having anywhere from 7 to 12 or more keyboards can profitably make use of a character reader. Where do the savings come from to pay for this expensive beast?

One place is the lessened cost of labor. Since manual input for the character readers is typically prepared on a typewriter, the hourly wage rate is generally lower than for keyboard operators, while the output is higher and the rate of errors is lower. The ease with which errors can be corrected when preparing typewritten documents contributes to the speed in comparison with keypunching. One user estimates that about 10 percent of the documents processed at his installation contain errors detected and corrected by the operator. Some readers contain special facilities for recognizing a character skip symbol or strike-throughs to further ease correction of errors detected by the typist.

Most optical character recognition systems consist of four basic units.

Document Transport Unit
Reading Unit
Recognition Unit
Control Unit

The transport unit moves documents past a scanner that converts the characters on the document into electrical signals that are then analyzed and recognized by the recognition unit. The recognition unit matches patterns or representations received from the scanner against stored reference patterns.

The transport moves the documents from an input hopper or feed roll past one or more scanning units to one or more output stackers. In certain equipment the documents are read while still moving, but in most cases, the document is stopped and read. Document transports employ combinations of vacuum, air blast, and friction to separate and feed individual documents, while belts and rollers are used to transport the documents past the scanning unit.

The speed of most OCR systems is limited by the speed of the document transport. The scanning unit determines the speed of the OCR unit when the amount of data per document is large.

Functional features or characteristics that effect the complexity of the document transport are:

Detection of double documents and jams
Detection and correction of document skew

The scanning unit converts the printed information on the document into electrical signals that will enable the recognition unit to recognize the printed characters. The five distinct methods currently in use for converting optical signals into electrical signals are:

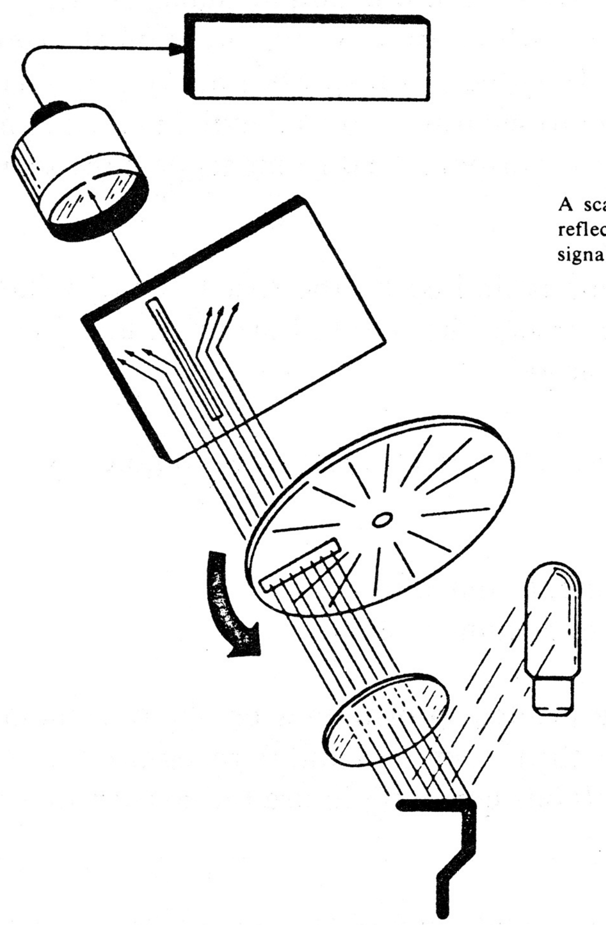
1. The rotating disc scanner uses a high quality lens system to project light reflected off the document onto a rapidly rotating disc. The rotating disc has

apertures extending from the center of the disc to its periphery. Behind the character image area on the disc is a fixed plate containing a single aperture. This aperture is so oriented that each aperture on the rotating disc successively intersects along the entire length of the fixed aperture as the disc rotates.

The rotating disc scanner reads one character at a time. Movement from one character to the next character or from line to line is accomplished by repositioning the lens system or by moving the document. Therefore, this type of scanner is relatively slow in comparison to other scanning methods mentioned.

The advantage of the rotating disc approach is that it is relatively simple, permits paper to be exposed to ordinary light (actually the more light the better), requires only one or, at most, a few photocells, and permits adjustment for different background colors by varying the threshold voltage.

The disadvantages of this method are that high-speed discs are noisy and difficult to manufacture and the throughput rate of the system is limited by the disc revoltion speed. It appears that about 400 characters per second is the upper limit for OCR systems employing this approach. Therefore, the rotating disc is being replaced by faster methods of scanning for a number of applications.

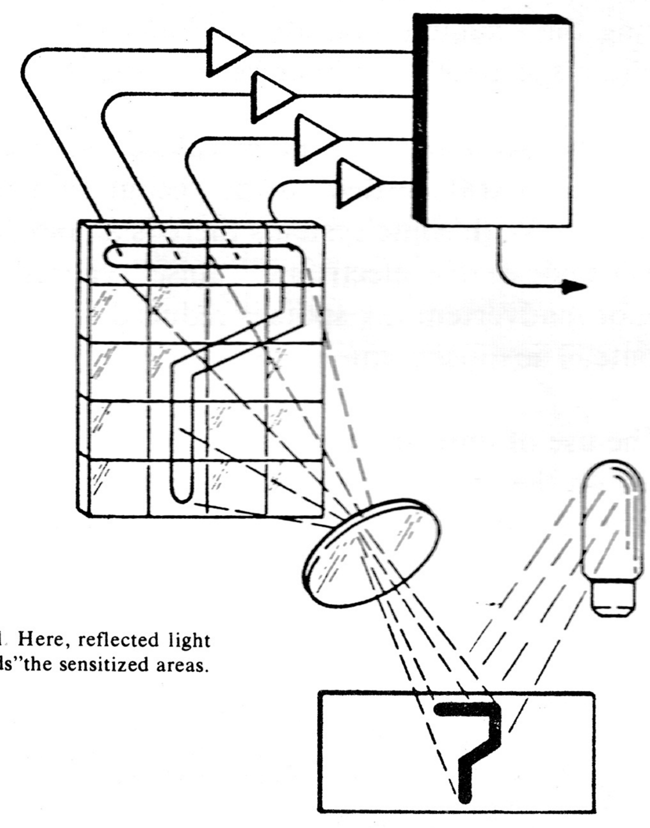


A scanner utilizing a rotating disk. The light source reflects off the image and is translated into electrical signals.

2. The flying spot scanning method uses a cathode ray tube (CRT) to generate a small (spot) of light that is projected onto the document being read via a lens system. The document must be located in a lightproof compartment where the reflected light can be picked up by one or more photomultipliers.

The CRT light beam is swept across the character in a raster-type screen by the CRT control logic. The beam can be moved very rapidly by the control unit to any location on the document. This ability enables a flying spot scanner to locate a line of print anywhere on the document without having to read the entire document. This positioning capability may also be used to follow the lines of a character, thus making it particularly adept at reading multiple font and hand printing.

3. In a photocell scanning system, a high intensity light source illiminates the document which is in motion and the reflected image is focused onto a grouping of photocells or light pipes which feed the photocells. The grouping of photocells can either be vertical, relative to the character being read, or it can be a parallel array of photocells.



A scanner utilizing a photocell. Here, reflected light is focused on a cell which "reads" the sensitized areas.

In the vertical grouping of photocells, each character is sampled as it moves from left to right. The use of a vertical grouping of photocells speeds up scanning operations by simultaneously sampling a number of points which, when combined, add up to a complete vertical slice of the character. The electrical signals generated by each of the photocells are then coverted into a binary mode and each slice is stored in shift registers until the entire character is sampled.

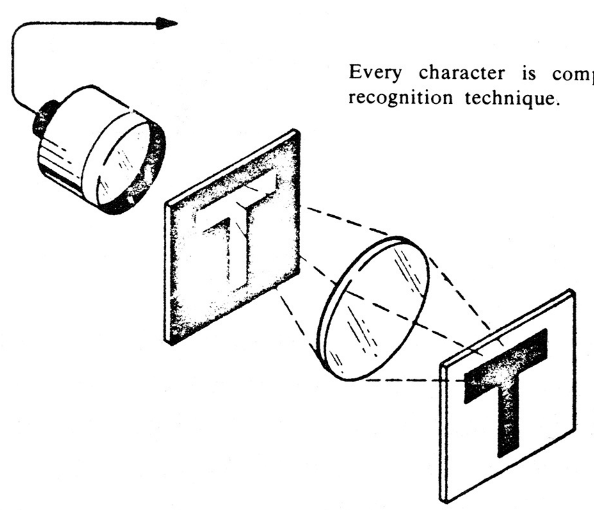
The parallel array approach looks at all points of a character simultaneously. The speeds of each method are comparable; however, in the parallel or full photocell array approach it is possible to measure analog information completely. This capability enables different shades of black and white to be read and thus provides a greater probability of recognizing a smudged or dirtied character.

4. The vidicon technique projects the characters to be scanned onto a vidicon television camera tube. The vidicon tube is instantaneously exposed to the characters (in camera fashion) by either flashing a light (flash tube) on the document when the characters are ready to be read, or the document is constantly illuminated with a strong light and a high speed electro-mechanical shutter is used to "snap the picture." The image on the face of the tube is then scanned by an electron beam which generates an electrical analog signal. The resulting signals are quantitized to digitally indicate black or white.

The vidicon scanner can store a group of about 45 characters on the face of the tube and, therefore, documents containing this number or fewer characters do not have to be moved during the scanning operation. With the development of much higher resolution vidicon tubes, it would be possible to store the entire document and eliminate mechanical movement completely during the scanning operation. Vidicon scanners are presently classified as medium speed (500) characters per second.

After the scanning has taken place, an electrical representation of the character is transmitted to the recognition unit which then identifies the character. With some systems there is an intermediate prerecognition step in which undesirable electronic "noise" caused by white spots on black ink, dirt, or inadvertent ink spots is reduced. The value of this technique is still in dispute. The most common types of recognition units currently in use are:

1. The use of optical masks is one of the earliest recognition techniques. It is based on the use of one or more photographic masks for each character. An attempt is made to measure how well the character projected matches with the mask.



Every character is compared to a mask in this recognition technique.

Photocells behind the mask measure the total light passing through the mask. Ideally, no light should pass through the mask if it matches the character being identified. In practice the match is usually not precise enough to blank out all the light so a threshold value is established as a tolerance.

This technique has the ability to identify a full alpha-numeric character set, however, small differences in character shape may cause character identification errors and high reject rates. No known commercial OCR systems are currently using this method. The concept has the potential for providing low-cost OCR systems if the input data can be closely controlled.

2. Matrix matching is a widely used recognition technique which stores electrical signals received from the scanner in a digital register that is connected to a series of resistor matrices. Each matrix represents a single reference character. Each resistor matrix is connected to a second digital register which contains a voltage representation of the character. The voltage of the scanned character is compared with the second digital register and the resistor matrix.

Recognition is based on the comparison of the voltage representations in the two-shift registers. This recognition technique is well developed and can handle a complete alpha-numeric character set and is easily modified to identify characters from several type fonts.

3. Analog waveform matching is a recognition method that has been used for some time, particularly in the magnetic character reader used by the banking industry. This method is based on the principle that each of certain characters passing under a read head will produce a unique voltage waveform as a function of time. Characters are identified by matching their waveforms against reference waveforms.

The major disadvantage of this technique is that only a small number of characters have easily identifiable waveforms, thus limiting this application to the reading of only numerics plus a few special symbols. Machines using this technique have reading speeds of approximately 500 characters per second.

4. Frequency analysis is a digital recognition technique developed for fonts using vertical lines. The CMC-7 font printed ith magnetic ink, is the most widely used example of this technique. The width of the gaps between the vertical lines of a character form a code that is unique to the character. Characters can be identified by comparing the frequency and number of the wide and narrow gaps with the stored codes for each alpha-numeric character. The advantages of this technique include the ability to handle a full character set.

5. Stroke analysis or feature analysis is a recognition technique based upon the differentiation of characters by the number and position of vertical and horizontal strokes or lines. The formation of the unknown character is matched by a special purpose computer against stored truth tables representing each reference character. The capability of this technique has

been increased to the point where hand-printed numerics, and several fonts can now be recognized.

The systems control unit performs data editing and formating, identifies and interprets various formats for different documents, sequences some systems operations, and provides the interface required to record data on an output device such as magnetic tape or punched card. The systems control unit may be a special or general purpose computer, or a plugboard.

In most of the early optical characters readers, systems control functions were performed with plugboards that greatly limited the system's flexibility and data processing capabilities. While some readers still use a plugboard, particularly mark sense and document readers, most current OCR systems and those expected in the future use a combination of systems software capability and a general purpose computer for control functions. The computer can be a mini-computer supplied as an integral part of the system or the reader can be operated on-line to a larger data processing system.

OCR devices with computer logic capability and specialized software are performing many sophisticated data processing functions such as validation of self-checking numbers, reconstruction of missing digits, and identification of characters by context analysis.

There is not too much to say about recognition of marks by a mark reader. Typically, they are diagonal slashes made in a preprinted box or outline. Care must be taken when erasing because if the paper is roughened too much, it will have a low reflectance and make the reader conclude that the roughened area is a mark. In general, more care must be taken with erasures than with the older conductive mark-sense technique.

The style of the type face printed is called a font. The group of symbols that the reader will recognize is referred to as the character set. Note that a particular reader may not read all the symbols of a particular font. The usual situation is that only the numerics are recognized of a font that also contains alphabetic letters. Occasionally, a larger set of characters can be recognized than are in the font proper.

There are many fonts that are used today in addition to traditional printing type styles. A few of the more sophisticated readers recognize printing type styles and in addition to or in place of the OVR printing type styles in addition to or in place of the OCR fonts.

The more commonly used OCR fonts include:

• NCR NOF (Numeric Optical Font) — This is a numeric font, usually imprinted by an adding machine or cash register. It is widely used in retail applications.

• ANS I and IV — Previously called OCR A and C, these fonts were developed by the American National Standards Institute and are likely to become the most widely used OCR fonts. The two represent two sizes of the same typeface. For perspective, the sizes are roughly equivalent to 10 point (I or A) and 14 point (IV or C) type. Imprinting devices abound, including

the IBM Selectric Typewriter, most other major brands of electric typewriters, and some line printers.

• OCR A and C — See ANS I and IV, above.

• ISO B — Popular in Europe, this font is now under consideration for standardization in the United States. It differs considerably from the ANS standard and is characterized by being closer to conventional type faces than the ANS fonts. Exponents of the ISO B font are concerned about readability by people, even though it is more difficult to build the machine recognition logic to handle it.

• Farrington 7B, 12F, and 12L — Another popular group of OCR fonts, due to Farrington's early appearance on the OVR scene. The three codes have somewhat similar shapes but differ in size and character set. The 7B and 12F are numeric fonts, while the 12L is alphabetic only. The 7B is much larger than the 12 F/L. Imprinting is normally done by a special typewriter or a credit card embosser.

• IBM 1428 — This is an alphanumeric font associated with the IBM 1428 Optical Reader and imprinted by an IBM 1402 Line Printer or IBM Selectric Typewriter.

• IBM 407 — A font produced by the widely used IBM 407 Accounting machine.

• E-13B — This is not properly an OCR font. It was developed by and for banks prior to the development of OCR. It is a highly stylized numeric font intended for printing an magnetic ink to facilitate the sorting and processing of bank checks. It has not caught on anywhere else, but most banks use it. Some optical readers can read this font, which enhances their suitability for banks converting to OCR.

All fonts, both numeric and alphanumeric, usually include a few special symbols for control purposes. The OCR A and C fonts include a full array of punctuation symbols as well.

The scanning technique is the method for optically converting the printed images to electrical signals. Some sort of photosensitive device, photocell or phototransistor, is used to sense the light reflected from the document. For bar-code and character readers, additional components are required to scan portions of the code or character in proper order so that the features, and thus the character, can be identified. The scanning components can be an array of photo devices, a mechanical disc, or a flying spot (CRT). The photo-device array is used by most bar-code readers. Size normally interferes with using it for scanning characters, but note that REI does quite nicely with it. The mechanical disc technique employs a rotating disc with a slit in it to project a beam of light over the character in a predetermined order. The flying spot scanner uses an electron beam that is moved within a CRT to generate a spot of light, thus providing, potentially anyway, a much faster scan rate. The flying spot scanner is very adaptable to reading multiple lines, while the mechanical disc scanning technique requires either an incremental document transport or an elaborate system of mirrors to scan multiple lines.

Once the printed image has been translated into electrical signals, the recognition logic interprets these signals as a particular character.

Three principal recognition techniques are used for character interpretation: matrix matching, stroke analysis, and curve tracing. Matrix matching involves comparing the matrix of signals caused by the reflecting (paper) and non-reflecting (printed character) portions of the character with a set of signals for each character until a match is found. Typically, the closest match within prescribed limits is identified, because a perfect set of signals is most unusual due to variations in print and paper quality. (The stroke analysis method is somewhat similar on a much simpler basis.) Readers employing this technique usually are reading a highly stylized font specifically designed for the technique. Curve tracing logic actually traces out the outline of the character to derive a set of signals for analysis. The curve tracing technique is adaptable to variations in character size and orientation, making it a good choice for interpreting hand-printed characters. However, breaks in the printed character tend to affect this method more than the matrix matching method.

The purpose of the optical reader is to generate data in a typesetter - readable form. Magnetic tape, punched cards, and punched tape are conventional computer-readable forms. De facto standards, now official, have been established by IBM for magnetic tape and punched cards. Teletype has done essentially the same for punched tape. Exceptions that are relatively new on the market are magnetic tape cassettes and 96-column cards — but neither of these have had much impact on the optical reader market, for the simple reason that they haven't had much impact on computers as yet.

Readers that handle one size of documents are easy to rate for performance because it is predictable. In a similar manner, a journal tape reader typically transports the tape at a fixed rate, with predictable performance. Readers that handle different sizes of documents and variable-size data fields are not as conducive to having their performance stated in simple terms.

Three ways of measuring the performance of optical readers are documents per minute, lines per minute, and characters per second. The documents-per-minute rating is usually most applicable to mark and bar-code readers, as well as to character readers that read only one or two lines. The lines-per-minute rating is usually most meaningful for journal tape readers. The instantaneous character scanning rate in characters per second is probably the most meaningful single measure for character readers that read whole pages of text.

Careful evaluation of timing information, which often becomes quite complex, is necessary to accurately predict the performance of the more sophisticated character readers. The size of the document, the amount and location of data on the document, and processing of the data read can all affect the rate at which documents proceed through the reader. One-line units can be affected by other activities of the computer, if running in a multiprogramming environment, or by poor programming of input/output functions.

Reject rates of 0.25 to 0.5 percent cause some users to become startled and

disillusioned when they see 30 or 50 percent of the documents going into the reject pocket.

There are three principal types of errors of concern to users of optical character readers: ambiguous characters, invalid data, and documents in poor condition.

Ambiguous characters are those for which the reader cannot make a decision about what character each should be. There can be many reasons. Typical ones include broken or poorly formed characters and dirt or other marks that are picked up by the reader. Handling of this situation varies with the reader and with programming. Many readers automatically rescan an ambiguous character. Some substitute a standard character for all unreadable characters and continue. Others display the character on a CRT screen for operator determination; sometimes adjacent data is also displayed to give the operator more context for making the decision. Printing quality and paper quality can drastically affect the incidence of this type of error.

OCR users quickly learned that the inclusion of checks in the data was extremely useful for insuring the maintenance of an adequate throughput level by reducing the number of rejected documents. This technique most frequently takes the form of repeated data fields, particularly for numeric entries. The technique is applicable only if the data can be processed and the actions of the reader controlled on the basis of the result.

Another commonly employed check is the check digit. The digits of a numeric field are manipulated, and there are several standard formulas, to generate a check digit. This digit is included in the input. The reader or associated processor generates another check digit while reading and compares it to the one read in. Failure of this check normally causes the document to be rejected.

Documents that have extraneous items on them (such as stamps) or that have been badly mutilated can cause misfeeding and/or jams. The typical character reader is far less susceptible to this kind of jam than the average card reader, but people have been conditioned not to fold, spindle, or mutilate punched cards.

To permit processing of the manuscript by an OCR system, the typed pages must satisfy the criteria of the OCR reader. Some of these constraints are:

-the type style must be one the OCR reader "knows"
-the character set should not exceed the character library
-the paper or document material must be acceptable to the reader
-the line length, and line placement, must be appropriate for the reader

The first step is to read the character, and this is done by using scanning techniques. A single point of light is moved over the character image, and the light and dark portions of the scanning pattern are fixed on a matrix. The dark portions of the image represent dots on the matrix, and it is then possible to assign X and Y co-ordinate points to the dots. Thus, the character image is converted to a dot pattern, and each of the dots can be represented electronically as a result of the X-Y co-ordinates.

OCR readers scan several hundred lines in each of the two planes to achieve fairly high levels of resolution. The process of reducing the image shape to a dot pattern on a matrix is sometimes called "digitizing", or converting the image to digital representation.

Scanners are either mechanical or electronic, with the mechanical scanners controlling the movement of the light point by means of mirrors. Some mechanical scanners position the document on a drum, and rotate the document to derive one plane, and a mirror establishes the other plane. Electronic scanners use CRT principles and control the light point by deflection plates.

Once the character image has been digitized, it is then passed on to the next stage, where the character being read is compared to a library of all known image patterns. This is called correlation. When a reasonable comparison is achieved, the character is identified.

The identified character is now passed on to the format and control element, where the material is organized for proper recording on the output tape. The control and format section also takes care of such things as discarding characters that had been deleted. Some systems also utilize a small TV screen, so that if the reader scans a character, but can not find a comparison in the character library, the unknown character is displayed for the operator to see. The operator can then interpret this image, insert the correct character back into the system via a keyboard, or take other appropriate action.

The output of OCR systems is either magnetic tape or punched paper tape. The higher speed machines use magnetic tape because of the higher recording speeds, although paper tape can also be used if the speed sacrifice is not important.

OCR has developed very slowly as evidenced by the fact there are currently only about 1,500 OCR installations versus about 80,000 computer installations, even though the first commercial OCR system was installed in January 1956, only three years after IBM shipped its first commercial computer. The primary reasons for slow growth of OCR were the lack of flexibility of the first generation OCR systems and limited view of the potential OCR market by the industry and potential users. Until recently, almost all OCR devices were limited to reading short vertical or horizontal dashes (mark sense), or highly stylized fonts designed primarily for OCR reading. The lack of flexibility of earlier OCR systems has been remedied and most OCR systems introduced since 1968 and those scheduled to be introduced in the near future are capable of reading a number of different type fonts, including hand-printed numerics plus a few symbols. In addition, the software programming has been greatly improved giving the systems considerable editing and formatting flexibility.

Optical character recognition systems can be classified by the complexity of the font selection which the machine can handle and by the physical characteristics of the media presented for reading.

OCR systems fit into the following categories when classified by font selection:

1. Optical Mark Readers
2. Stylized Font Readers
3. Multifont Readers

Optical mark readers are an improvement in the mark sensing techniques where the location of graphite pencil marks was determined by measuring the electrical conductivity of the pencil mark. Now, most mark reading is done optically. At one time, optical mark readers were used primarily in scoring tests and questionnaires and in survey applications. Today, they are also used as data acquisition devices in payroll, inventory control, meter reading, and a number of similar applications.

The scanning systems of optical mark readers and optical character readers are basically the same, but their recognition systems differ greatly. Both systems use a set of photocells to detect a drop in reflected light caused by a mark or character on the paper. The recognition system for an optical character reader is considerably more complex than that of an optical mark reader. An optical mark reader recognizes only the drop in light and determines the value of the mark by noting its position in relation to some reference point such as the beginning of a line. An optical character reader notes not only the gross drop in light but the coordinates on a two dimensional grid at which the drop occurred.

There are approximately 50 major type fonts used by computer printers and typewriters. This large number of different fonts has presented a great restraint on the development of optical character recognition systems. In order to control data input, the initial manufacturers of OCR equipment created special stylized fonts that were compatible with the design of their own equipment. This lack of standardization during the past decade has severely limited the growth and acceptance of OCR as an input technique.

A number of type fonts have been developed over the past several years for machine reading. The USA Standards Institute has recommended a type font that is generally suitable for typewriters and is also suitable for OCR. The USASI OCR-A font is the most common font, and is read by almost all OCR systems.

The International Standards Organization has developed a font called ISO-B which includes upper and lower case letters. This font is designated by USASI as OCR-B.

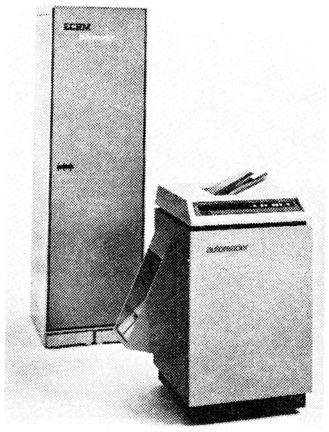
The stylized font reader will generally accept one or more fonts.

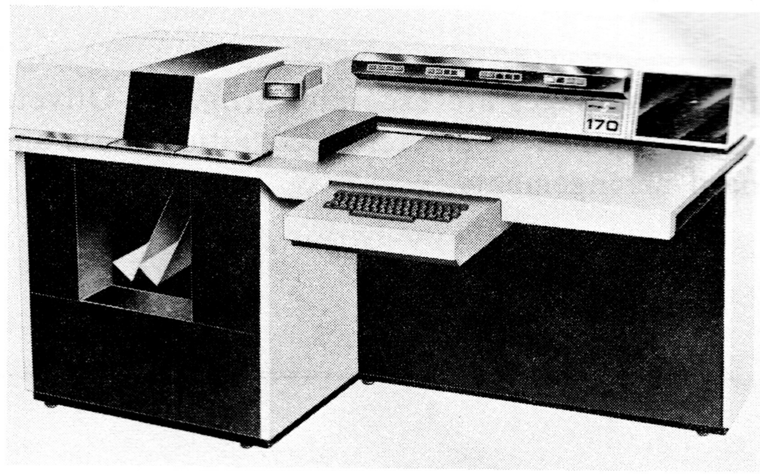
Multi-font readers will accept, as a minimum, a small group of standard typewriters or printed fonts and will usually read both upper and lower case. Several multi-font readers will also read hand-printed alphabetic characters. In these machines, the fonts are known in advance and the machines are either programmed to read one font at a time or to read several fonts intermixed. OCR equipment designed to read a multitude of intermixed

fonts can experience a substantial loss in reading reliability as well as a significant increase in cost over a reader capable of reading only a limited number of fonts.

Most OCR equipment currently being developed and marketed includes both OCR-A and OCR-B font capability within their character recognition logic. This action is very important to the future growth of the OCR industry, as standardized type fonts with machine processing capability should accelerate cooperation by users and manufacturers of business forms and data processing equipment. Standardization of type fonts will also enable OCR systems to become less expensive and should accelerate the replacement of keypunch installations with OCR installations.

OCR equipment can be classified into general product types according to the physical characteristics of the media presented for reading.





Above, the ECRM Autoreader; right, the Model 170 from CompuScan.

Model	**CompuScan Model 170**	**Datatype Setype**	**Datatype Dataflow**	**ECRM Autoreader**
Cost				
Basic Cost	$36,000 - $64.000	$19,500	$9,950 - $17,000	$89,000
Monthly Rental	$720 - 1,310	$800 p/mo. Min. 1 Year Lease	$670 p/mo. Min.1 Year Lease	$ 1,900
Input				
Media	Pages; Documents	Pages	Pages	Pages; Documents
Paper Size: Minimum	3"x 5"	8½"x11"	8½"x11" (automatic)	8½"x 6"
Maximum	11"x14"	8½"x11" (automatic)	8½"x11" (automatic)	8½"x48"
Output				
Magnetic Tape	9 Track; 800 bpi	No	7 or 9 Track; 556 or 800 bpi	7 or 9 Track; 800 bpi
Paper Tape	50 to 8 Level	6-Level TTS; 1200 bps	7 or 8 Level	5 to 8 Level
Other	Communications Lines (optional)	No	1200 bps (communications lines)	1200 bps Communication Lines
Function				
Characters per Line	To 70	0-70	0-70	To 75
On Line	Yes	No	Yes	Yes
Off Line	Yes	Yes	Yes	Yes
Data Form	Characters	Binary Bar Code	Binary Bar Code	Characters
Reading Rate	100 cps	60 cps	60 cps	90 cps
Characteristics				
Characters Read	OCR A, OCR B, Perry (IBM), 88 Characters, Upper and Lower Case, Plus 10 Special Characters	Datatype DF-2 Font, Alphanumeric, Upper and Lower Case; a Binary Bar Code Is Produced Under Each Character. Programmable w/Bar Codes on Typewriter	Either Datatype Font DF-1 or DF-2; Using a Special IBM Selectric Element, a Binary Bar Code Is Produced Under Each Character. DF-1 — Alphanumeric, Upper Case Only DF-2 — Alphanumeric, Upper and Lower Cases	OCR A, OCR B, Courier 12
Error Control				
Rescan	Yes	Yes	No	No
Reject	Yes	Yes	Yes	No
Manual Correction	Yes	Optional	Optional	Optional
Scanning	Fiber Optics	Photo Transistors	Photo Transistors	Vidicon
Recognition	Matrix Matching	Binary Code	Binary Code	Feature Analysis
Non-Read	Libht Blue or Red Text or Marks	Light Blue or Red Inks; Delete Key	PMS 304 Light Blue or PMS 178 Light Red	Normal Proofing Marks
Size	75" L; 29½" W; 38 5/16" H	Desk Size	22" L; 23" W; 9" H	23½" W; 23" L; 44" H
Power	115 V, 15 Amps	115 V, 10 Amps	200 W	115 V, 25 Amps
Computer	*Custom	Digital PDP-16 (included)	None	Digital PDP-8; IBM 1130 and 360; and GA 1830

*IB 1130; Digital PDP-8; TAL-STAR 1830; Fairchild 330-I and Others

The following pages are excerpted from the Olivetti manual on Optical Character Recognition fonts and keyboard arrangements.

FOREWORD

This booklet illustrates the most common Editor 2 keyboard arrangements for use in Optical Character Recognition applications.

When ordering an OCR Editor 2, the following questions must be answered:

1. What character set is the Optical Reader programmed to recognize?

2. What Keyboard will the application require?

3. What Keyboard modifications will be required due to special symbols such as the character delete?

4. What size carriage will be required to accommodate the form size?

5. Will the forms be continuous or cut sheets?

6. Will carbon or fabric ribbon impressions be required?

Use the following information to obtain answers to the above questions.

Character Set

A keyboard number is located in the space bar on each keyboard diagram. This number, used when ordering, describes both the keyboard arrangement and the character set. For example, keyboard 2-903-1 indicates a 10-Key Keypunch cluster keyboard arrangement and the USA Standard Character Set.

A type sample precedes the diagrams of the keyboards available with each character set. The Optical Reader will determine the character set that is required.

Keyboard

After determining the character set, the keyboard should be selected.

The keyboard should be chosen to meet the needs of each application. A description of each keyboard has been included for this purpose.

Keyboard Modifications

The special symbols will also be determined by the Optical Reader. The most frequently used character combinations are listed on page 3 . Others are available upon request. Any keyboard may be modified to include special symbols, when required.

Carriage Length

The size of the form will indicate the length of the carriage to order.

Pin Feed Platen

When continuous forms are used, a pin feed platen may be installed on the Editor 2. Refer to the current Technical Information Bulletin (TIB) for the ordering procedure, prices and installation data. Additional information is contained in the Features and Attachments Booklet.

The maximum form widths for each pin feed platen are:

Carriage length	Maximum form width
13"	11 7/8"
17"	15 7/8"

2

Ribbon

Most Optical Readers recognize impressions produced by carbon ribbons.

USASI* OCR type style and keyboards

THIS IS A SAMPLE OF THE UNITED STATES OF AMERICA
STANDARDS INSTITUTE, USASI*, OPTICAL SCANNING TYPE FACE.

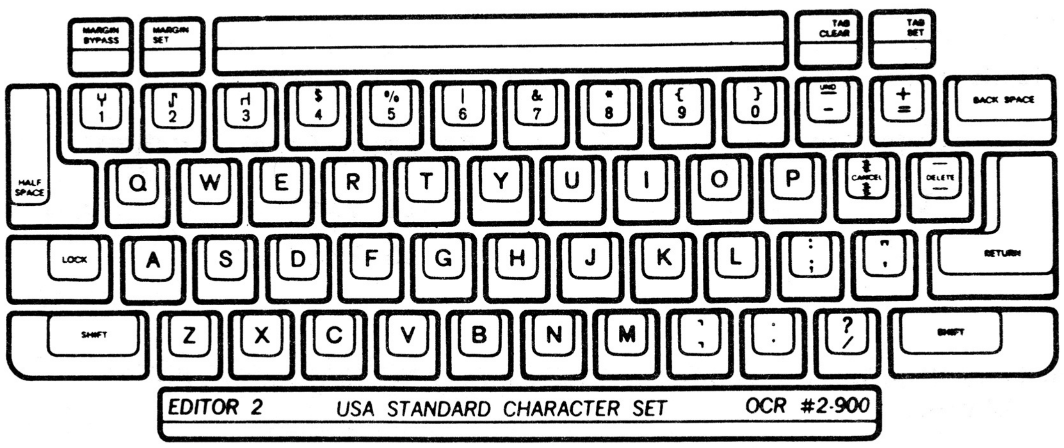
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890 ⑂⑀⑁$%|&*{}_-+= —:;"',.?/ ⑄

Optional character combinations

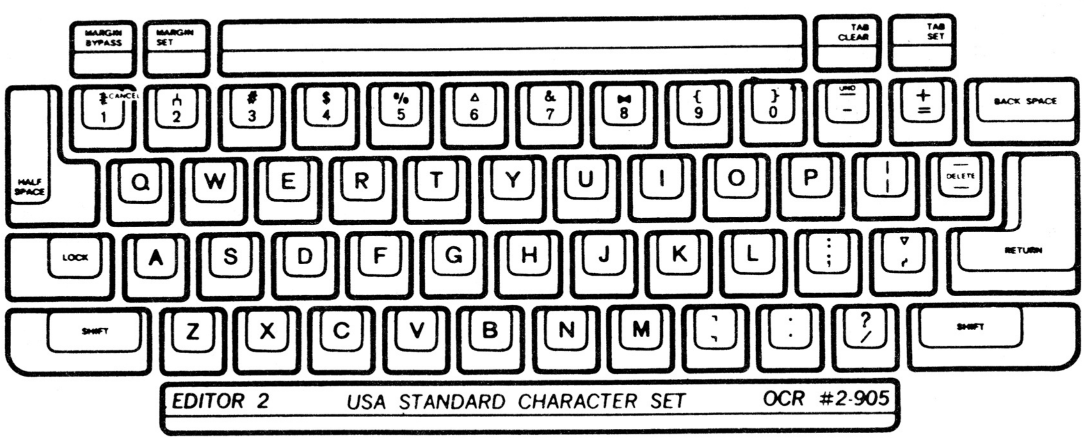
others available upon request.

*Previously known as the American Standards Association (ASA). Identified internationally as OCR-A.

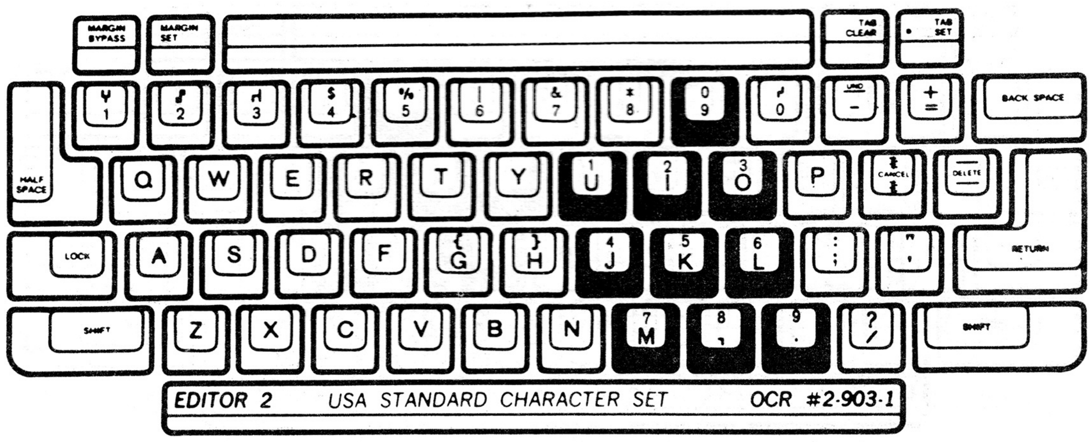
Upper case alphabetic USASI characters are located in both shift positions on keyboard 2-900. Less shifting and greater typing speeds are the advantages of this keyboard arrangement.



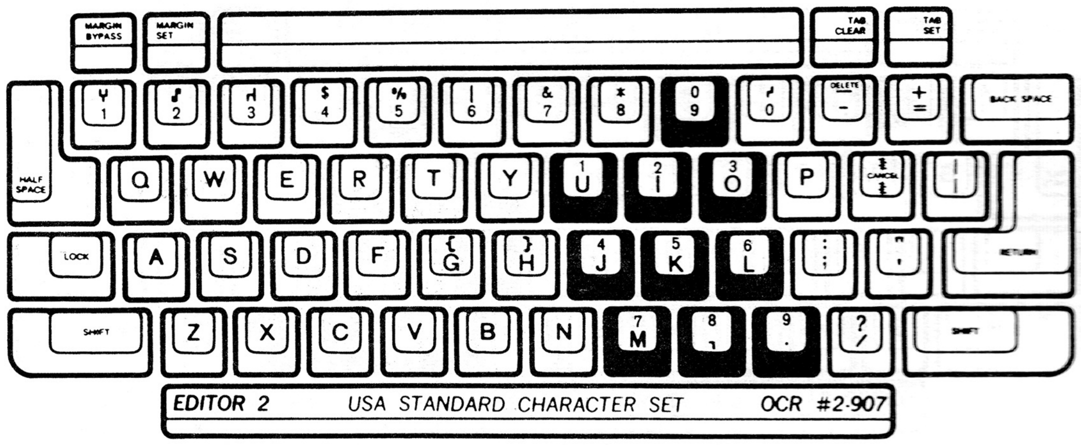
Keyboard 2-905 is used with optical readers that recognize different symbols from those on keyboard 2-900. Both are used for the same applications.



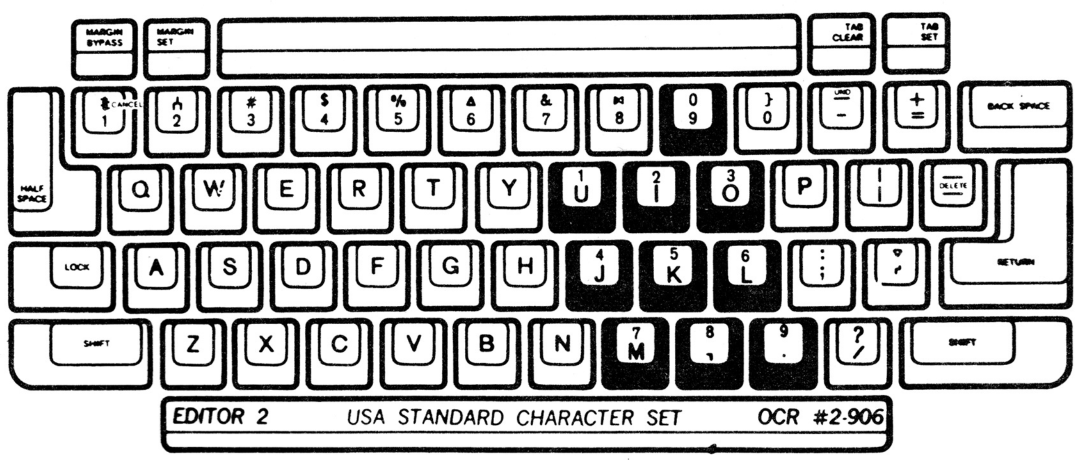
Keyboard 2-903-1 is used when the OCR typing application contains a large amount of numerical information. It contains upper case alphabetic USASI characters and the 10-key keypunch cluster. Numerics can be entered quickly and easily with this keyboard arrangement.



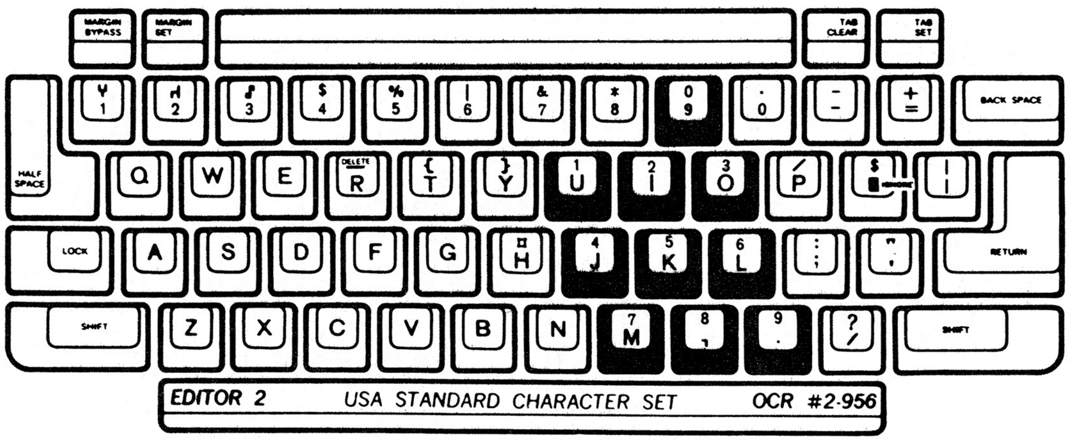
Keyboard 2-907 is used when typing a large amount of numerics on forms that do not have pre-printed field separators. This keyboard differs from keyboard 2-903-1 by containing field separators in both shift positions in place of the group delete. The group delete replaces the underscore. Less shifting and greater typing speeds are the advantages of this keyboard arrangement.



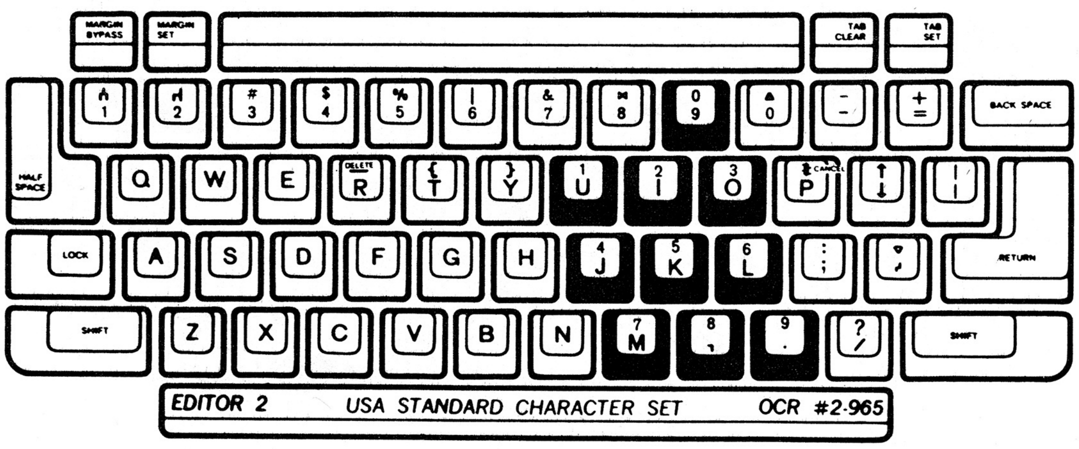
Keyboard 2-906 is used with optical readers that recognize different symbols from those on keyboard 2-903-1. Both are used for the same applications.



Keyboard 2-956 contains upper case alphabetic USASI characters and the 10-key keypunch cluster for rapid entry of numerics. It is recommended only for accounts using competitive typewriters to maintain keyboard uniformity.



Keyboard 2-965 contains upper case alphabetic USASI characters and the 10-key keypunch cluster for rapid entry of numerics. It is recommended only for accounts using competitive typewriters to maintain keyboard uniformity.

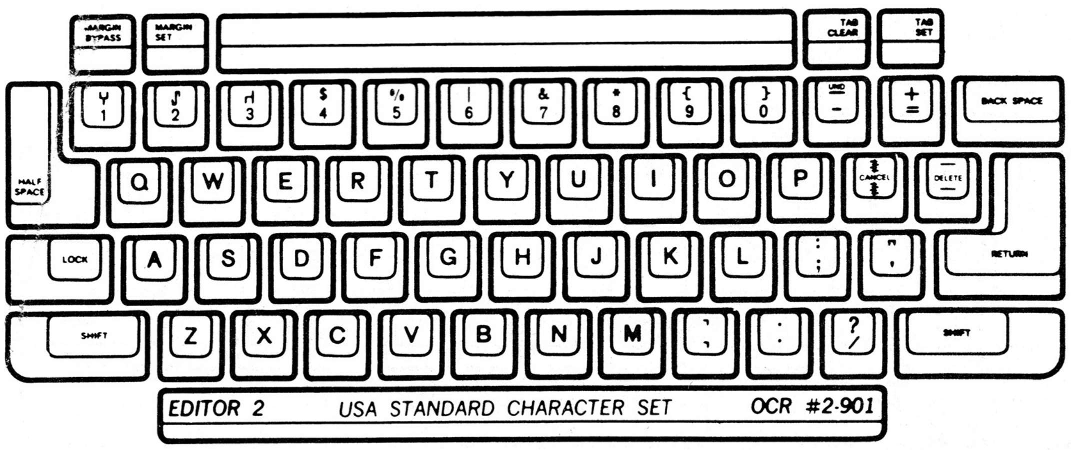


5

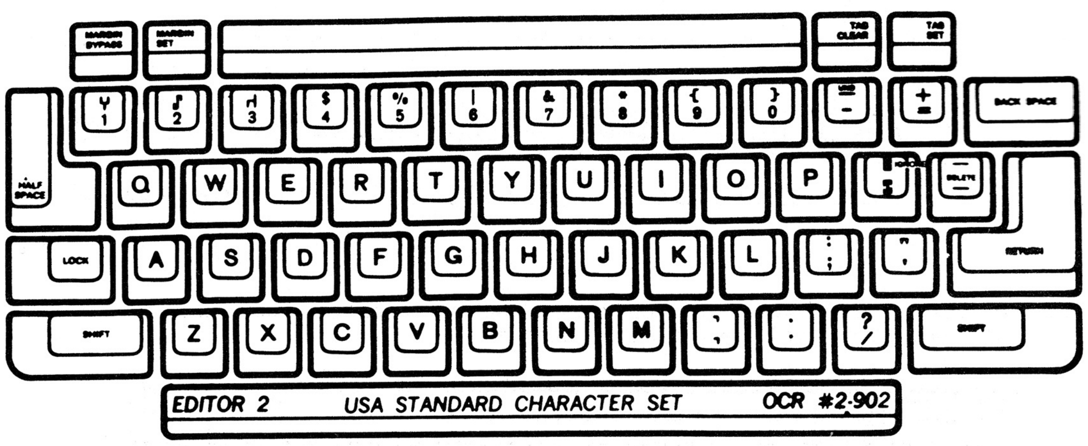
```
This type style is used for general correspondence
by combining the lower case, illustrated in this
sample, with the USASI type face.

ABCDEFGHIJKLMNOPQRSTUVWXYZ     abcdefghijklmnopqrstuvwxyz
1234567890    Y⅃H$%|&*{}_-+= —:;"',.?/‡
```

Keyboard 2-901 is used in two ways. The upper case alphabetic USASI characters are used for OCR typing. For general correspondence typing, use this keyboard in the conventional way.



Keyboards 2-902 and 2-901 are the same except for two character erase symbols. Keyboard 2-902 is used whenever the optical reader recognizes either ▮ or ‡ for error correction.

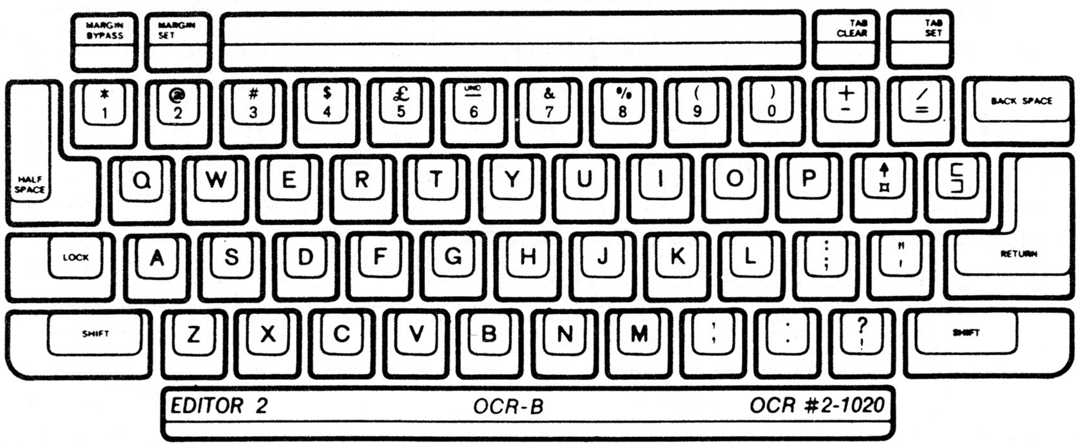


Other OCR type styles and keyboards

This is a sample of the OCR-B Optical Scanning type face. It meets the specifications of the International Organization for Standardization.

ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
1234567890 *@#$£_&%()+-/=↑¤[]:;"',.?!

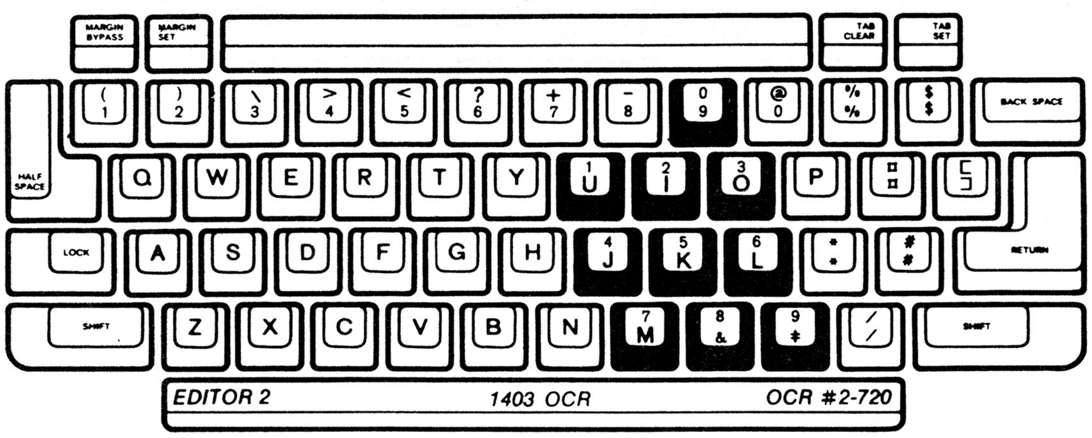
The OCR-B character set contains both upper and lower case alphabetic characters. This keyboard is used for OCR and general correspondence typing.



THIS IS A SAMPLE OF THE 1403 OPTICAL SCANNING TYPE FACE

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890 ()\><?+-@%$¤[]*#&‡/

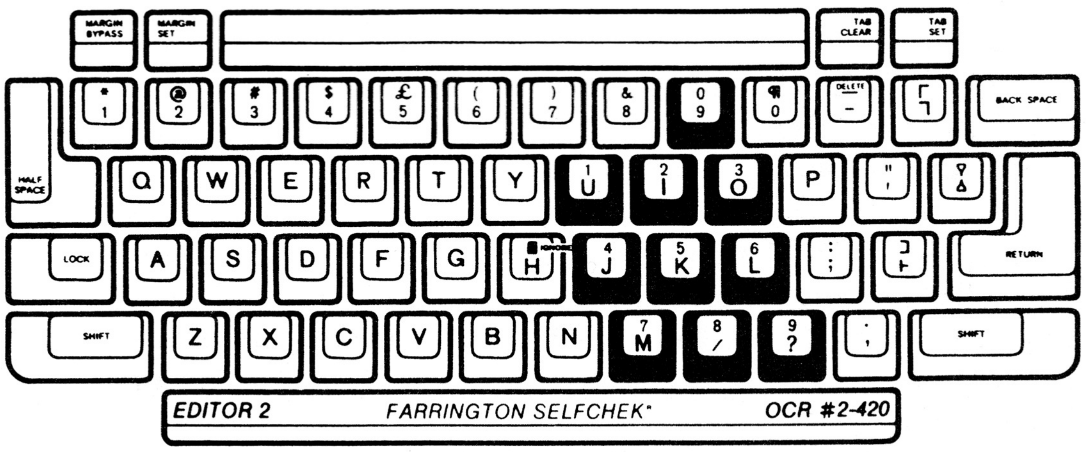
The 1403 OCR character set contains upper case alphabetic characters. This keyboard includes the 10-key keypunch cluster for rapid entry of numerics.



THIS IS A SAMPLE OF THE FARRINGTON SELFCHEK® 12F/12L
OPTICAL SCANNING TYPE FACE.

ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890 *@#$£()&¶—-┌┐"'∇∆█:;┐├/?.,

The Farrington Selfchek® character set contains upper case alphabetic characters. This keyboard includes the 10-key keypunch cluster for rapid entry of numerics.



8. What a computer does

The Fall of 1962 saw computers utilized in typesetting for the first time. Both the IBM 1620 and RCA 301 were general-purpose computers programmed to accept non-justified paper tape input and produce justified *and hyphenated* paper tape to activate linecasting units. The perforator operator typed an "endless" or "idiot" tape with no end-of-line decisions; however, codes for font, measure, quadding and other typographic functions were encoded. Essentially the computer performed electronically what the counting perforator and linecasting spaceband did mechanically. The computer added the important function of word division. Two methods were used: logic (or probability) and dictionary (or lookup). Here is an example of a probability program based on certain rules of logic. This limited but somewhat effective program is used in Compugraphic phototypesetting units.

Photo Unit Hyphenation Program

With the hyphen switch in the ON position the following sequence must occur before a line ending decision is made where the machine will automatically insert a hyphen:

1. The machine must have read at least two letters in a word.

2. A letter in the Kb group must be followed by a letter in the Kc group:
   Kb - B, C, D, F, M, N, P, R, T, V, X, Y
   Kc - B, C, D, F, J, M, N, P, S, T, V, W, Z

3. That there are at least 2 letters following the hyphen location to bring over to the next line.

4. That the word the hyphen location is found in will meet the requirements to make a line ending decision, ie., that there are enough characters and bands for justification.

5. That the insertion of the hyphen does not overset the line with band expansion at minimum.

Discretionary Hyphenation

Discretionary hyphenation requires the operator to insert a tape feed between letters in a word that is a good hyphenation location. The machine will insert a hyphen in this position if it is a good line ending point.

Dictionary programs stored a large number of words in the computer's memory and compared them with words at the line ending point. Correct break points were indicated. An "exception dictionary" is a limited list of proper names and other words that do not adhere to the rules of logic. The computer thus reduces the input burden by eliminating the need for an operator's end-of-line decisions.

A general-purpose computer may be programmed to perform a variety of tasks, such as accounting or billing. A special-purpose computer does only one job, such as justification. One of the first such special-purpose computers was the Compugraphic Lineasec, which required a monitor to make the end-of-line decision for words appearing on a CRT screen. The next and much more popular version was the "automatic" Justape (also from Compugraphic). Here, the raw tape entered one side and a justified tape exited on the other.

Computer programs may be as simple or as complex as the typesetting device and job to be set require. A machine such as the Photon 532 with 32 typefaces and 23 sizes requires extensive programming to store all the character width valves and to "mix" typefaces and sizes in the needed format. A format is a repetitive layout, such as a grocery ad or a book page, that may be programmed into the computer and accessed via a few keystrokes. Characters input after a format command are "automatically" set in the desired face, size and position.

Key to Computerized Composition

Word division and hyphenation are deceptively simple in theory - simply divide between syllables. But it becomes complex in practice because of preferential breaks, rule of syllabication and exceptions to these rules, and exceptions to the exceptions. The collision between the strict logic of computers and the preferences and exceptions of word divisions has presented computer programmers with one of their most challenging problems.

The simplest approach was taken by the Compugraphic Linasec. This machine relied on a monitor to select hyphenation points when a machine was unable to end a line on a word space. According to the Linasec reasoning, many typesetters will not be able to recoup the cost of the large general purpose computers required to divide words automatically - their composition volume will not be big enough. Therefore, typesetters need computing equipment that handles only the specialized work of typesetting, leaving the work that requires general-purpose capability - hyphenation-to the best general-purpose computer of all, which is a man. Then came the mini's!

Elements other than the word breaks themselves often enter the problem, such as a case that one programmer encountered. In this instance he told the computer that a widow of three characters was permissible - whereupon the computer produced a line containing only a period and two closing quote marks.

This problem, of course, was easily solved by adding extra instructions to the program defining what was to be considered a character in this instance. But it lengthened the program to be stored in the computer memory, and memory capacity is probably the most precious commodity in computers used for composition. Additional memory capacity can be added to the system, but only at extra cost.

The choice of program approach often will be dictated by other circumstances, as the cases of two newspapers illustrate:

At a leading Western newspaper, a logic system based on grammatical rules of word division was used to guide an RCA 301 computer. It achieves about 85 percent accuracy in hyphenation - that is 85 percent of the lines ending with a word split are correctly broken according to Webster's first choice.

Lines incorrectly broken are then reset manually after the type has been cast. If the computer hyphenates one line in eight, an accuracy of 85 percent will mean resetting 30 lines in 800 (two lines must be reset for every word division error), or 3.75 percent of all lines set.

While corrections of this sort are simple to make in hot metal, they are far more difficult in photocomposed film. A Florida newspaper chain had been developing film composition techniques for several years, and any computer installation they made had to be compatible with film composition. They felt 85 percent accuracy would create an uneconomical correction problem.

To increase hyphenation accuracy, they installed an RCA 301 computer with auxiliary magnetic tape memory capacity. In this memory they stored some 40,000 root words of five characters and up, in groups to speed access during operation. Words that break properly according to simple logic rules are excluded from the computer's dictionary. With this system, they can achieve a 99 percent accuracy rate with adequate quality for their newspapers. This means resetting a maximum of two lines in 800, or a little more than .3 percent of the total lines produced.

In display advertisements and children's books lines of text rarely end in a divided word, since word division would tend to disrupt the reader's concentration on the content. Divided words would be unnecessarily confusing to young readers. Some technical manuals and several newspapers currently in print also do not contain divided words. In both cases, however, the reason for not dividing words is primarily an economic one. If the text is prepared manually, the operator has to make certain hyphenation decisions which take time and therefore have a cost associated with them. If an electronic or mechanical device is used for producing text, these devices are usually less expensive if they do not contain hyphenation capabilities. Thus, there is definite cost that can be attributed to the division of words, and by eliminating hyphenation this cost can be reduced or avoided.

The alternative to dividing words at the end of a line is to produce lines of unequal length by eliminating word division. When these lines are grouped together into a column of text, the right-hand margin of the column is ragged rather than flush. Such a column is generally considered harder to read

because the eye must constantly adjust its scanning arc. Therefore, a column with a flush right margin should be easier and faster to read.

The desirability of a flush right margin does not necessarily mean that words at the end of a line need be divided. There are techniques in current use for producing flush right margins without resorting to hyphenation. One technique is to letterspace a word, several words, or a portion of a word in the line. The extra space that can be used by a hyphenated word at the end of the line is divided up instead and placed between the letters of a word in the line. The word or portion of the word is therefore spread apart when it appears in print. This sometimes makes the letterspaced word extremely difficult to recognize and impairs speed and comprehension. Another technique is to take the extra space and insert it in equal amounts between the words which comprise the line. This produces larger interword spaces, frequently resulting in distracting and unsightly rivers of white space in a column of text. Another technique is to divide the extra space on the line by the number of characters in the line and to increase the set size of each character by this amount. Varying the set size in effect letterspaces each word in the line proportionately. Even though the set size of the type may differ from line to line, there is so little difference that the distraction to the reader is at a minimum. However, this technique is extremely difficult to implement.

Also the larger the column measure, the more interword spaces and characters are available into which the remaining space can be placed, thereby lessening the need for hyphenation.

Thus, the primary reason for the prevalence of divided words at the end of a line is basically stylistic. Flush right margins are desirable for both ease and speed of reading. In addition, the appearance of uniform columns of printed matter is very pleasing to the eye. In order to achieve this stylistic treatment, the hyphenation of words at the end of some lines is almost always a requirement, since the alternatives are graphically unacceptable or incapable of being produced on the majority of composition devices.

There is an additional reason why hyphenation of text is required. Given a fixed amount of area into which printed matter can be placed, more text can be fitted in if words at the ends of lines are hyphenated. Similarly, a given amount of text can be placed in a smaller area if hyphenation is employed. A book or newspaper may then require fewer pages, with resultant saving in paper or composition. This saving can often outweigh the cost of producing hyphenated text, especially since the inception of computerized text processing.

Once the requirement to hyphenate words is imposed, the problem becomes one of simulating the human decision process.

By definition, hyphenation is the division of a word into its component syllables. A syllable is defined as one or more letters, constituting either an entire word or part of a word, which are pronounced as a single, uninterrupted sound. The syllable is the basic unit of pronunciation and consists of one single prominent sound and usually one or more less

prominent sounds. For the majority of English language syllables, the single prominent sound is usually a vowel, and the less prominent sounds are usually consonants.

The pronunciation of a word determines the letters comprising each syllable in the word. A glance at the pronunciation key in the front of any dictionary shows that the same letter can be pronounced in many different ways. These pronunciation variations are a problem in any hyphenation routine because they are not usually reflected in the spelling of the word, and a computer can use only the alphabetic structure in simulating the human decision process.

A human usually divides the word by pronouncing the word slowly syllable by syllable. A computer can simulate this process by scanning the word and isolating the vowels in the word. The isolation of the number of vowels in the word will not indicate anything about positive hyphen placement; but hopefully it will indicate the number of syllables in the word. Since the number of hyphen points in the word is one less than the number of syllables, this process will yield at least some indication of the number of hyphens to place in the word. However, this technique is fraught with problems because the same letter in different words may be pronounced differently or not at all. For example:

1. The majority of English words ending in the letter E are pronounced so that the E is silent. The words FACE and WRITE both contain terminal silent E's. A computer program that indicates two vowels in each word may therefore assume incorrectly that each word contains one hyphen point. The problem cannot be solved by always eliminating a terminal E from the vowel count because that will produce incorrect results for words like ASPOSTROPHE, and MAYBE. The problem becomes more complex when the silent E occurs within a word. In the word BASEMENT, the first E is not pronounced and therefore should not be considered in a vowel count.
2. A number of English words contain syllables consisting of several vowels and consonants; for example, TONGUE and TORQUE. In both cases, a vowel count indicates that several hyphen points can be placed in each word, whereas pronunciation indicates that the word cannot be hyphenated because it contains only one syllable.
3. A number of English words also contain consecutive vowels that are pronounced as one vowel. The words THROUGH and BLEED contain examples of this condition. A computerized vowel scan can solve this problem by considering contiguous vowels as a single vowel. However, this assumption will produce incorrect results in a word like REALITY, where consecutive vowels are pronounced separately.
4. The letter Y sometimes behaves as a consonant and sometimes as a vowel. In the word SYLLABLE, the Y behaves as a vowel, while in the word VINEYARD the Y behaves as a consonant. In general, if a Y is preceded by a vowel, it can be considered a consonant.

The problems caused by variations in pronunciation are epitomized by the homographs which exist in the English language. Homographs are words that are spelled identically but pronounced differently and, therefore, possibly divided differently. For example, the word PRESENT can be either a noun or a verb depending upon the context in which it is used. If the word is used as a noun, it is hyphenated after the S; if it is used as a verb, it is hyphenated before the S.

Each of the problems noted above exists because syllabication is based upon pronunciation, and pronunciation is often unrelated to the alphabetic structure of the word. However, there are a number of words which are not hyphenated according to the way they are pronounced. For example, the words DOUBLE, MILITIA, and VISION are hyphenated according to conventions established by printers and writers. Word division is actually based on many different considerations: pronunciation, conventions and traditions in general use by printers and writers, etymology, component elements, context, etc. Considering the diverse bases for word division, it is understandable why so many inconsistencies exist in the hyphenation of English words. The inconsistencies resulting from just the variations in pronunciation should give some idea of the formidable problems that had to be solved in computerizing word division.

Words which contain alphabetic and nonalphabetic characters or words which consist entirely of nonalphabetic characters are also problems:

1. Alphameric words consisting of letters and numerals. This type of word most commonly occurs in parts catalogs and technical publications.
2. Words that contain punctuation marks such as periods, question marks, and commas, when that word ends a line or a phrase.
3. Compound words or phrases whose elements are separated by text-supplied hyphens or em dashes. For example, an em dash usually separates the elements of a telephone number, and a text-supplied hyphen usually separates the elements of a compound word such as RE-ENTER.
4. Words that contain apostrophes; for example, the possessive form of a word (HENRY'S) or a contraction (WON'T).
5. Words like "MacDonald" that contain both upper and lowercase alphabetic letters in the word.
6. Words consisting entirely of nonalphabetic characters, for example, $12.38 and 1,000,000.

The problem inherent in the above examples is not to recognize the nonalphabetic characters but to be able to make some decision about hyphenation-point placement based on these characters. For example, words which contain text-supplied hyphens can be broken at the point where the text-supplied hyphen occurs, and words like "MacDonald" can be divided just before the change from lowercase to uppercase characters. The problem of dividing mixed words is compounded by the fact that rules for mixed-word division are determined to a large extent by the stylistic inclinations of the user. Nevertheless, a generalized hyphenation routine must provide the ability to hyphenate mixed words.

Not all of the problems associated with computerized hyphenation are due solely to the idiosyncracies of the English language or to the requirement to hyphenate mixed words. Two of the primary objectives of any hyphenation routine must be to maximize hyphenation accuracy and to minimize the time required to hyphenate the average word. The fastest and most accurate hyphenation routine might not be practical for the general user if a large and expensive system configuration were required.

With the application of computers to text processing and the requirement for

the division of words at the end of a line, a number of techniques for the division of words have been developed. In general, these techniques can be divided into two basic types -- dictionary and rules (algorihmic methods.)

Perhaps the simplest computerized word division technique consists of storing all commonly used words with their associated hyphen points and then searching this huge dictionary each time a word is to be hyphenated. A primary disadvantage is that every word requiring hyphenation may not be in the dictionary. In order for the dictionary to contain all the words that might need to be hyphenated, especially when one considers proper names and "made up" words, computer storage requirements and execution time would be prohibitive.

A second dictionary approach consists of storing commonly used suffixes and searching this suffix table to see whether the word to be hyphenated contains one of the suffixes. Since English is fundamentally an agglutinative language, a hyphen point usually occurs in the word before the suffix. Even though suffix analysis can pinpoint a word division point in some cases, a number of exceptions to these rules do exist. For example, the suffix -ING is usually preceded by a hyphen point, as in the words SAIL-ING, GO-ING, and COM-ING. However, some technique must be employed to correctly hyphenate words such as PE-KING, BET-TING, and FLEDG-LING, since these are exceptions to the general rule. In these cases, the suffixes -KING, -TING, and -LING can also be made suffixes and placed in a suffix table so that they will be searched before -ING. Even though a certain amount of hyphen placement data can be obtained from a suffix analysis, these examples point out the difficulty of compiling a proper suffix dictionary in order to minimize the number of exceptions.

A prefix table may also be utilized for the same reasons that a suffix table is used. But the same problem of exceptions also exists with prefixes. For example, the prefix TRANS- appears in words like TRANS-PARENT and TRANS-FORM, but the words TRAN-SCRIPT and TRAN-SCEND violate the rule. An analysis of a large sample of English language words indicates that there are a great many more exceptions to prefix analysis than there are to suffix analysis; for this reason, prefix analysis is difficult to implement, and quite often the amount of coding needed is not worth the amount of hyphen placement data obtained.

The second general type of computerized hyphenation technique is generally referred to as rules or algorithmic. An algorithm is a well defined process or set of rules for the solution of a problem in a given number of steps. With relation to hyphenation, the rules are usually the result of extensive statistical or phonetic and contextual analysis of a large sample of English words. The development of any algorithm is plagued by two major difficulties:

1. The accuracy of the algorithm is directly related to the content and size of the data base from which it is derived. An algorithm based on a small sample of words which does not include the majority of commonly used words cannot be expected to correctly hyphenate a large portion of commonly used words. An algorithm derived from a data base of only scientific terms, for

example, may be highly inaccurate when used to hyphenate proper names or words from another discipline.
2. Normally, most computerized algorithms can analyze a word for division points based only on the word's alphabetic structure. Hyphenation of English words is primarily based on phonetic or contextual considerations; however, each algorithm must in some way solve this problem if a reasonable amount of hyphenation accuracy is to be obtained.

Because of the two general difficulties noted above, most of the currently used algorithms have one major shortcoming —the existence of exceptions to the rules of the algorithm.

One algorithm that has been used is based on the observation that, for a greater number of words, hyphen points exist after the third, fifth, and seventh letters of the word. This algorithm is surprisingly accurate considering its simplicity, but the number of exceptions to this rule are too many to permit its use without extensive augmentation with other techniques.

One algorithmic technique consists of storing, for each of a large number of strings of characters, the probability that that string of characters comprises a syllable.

Another algorithmic method that has been developed is commonly known as the tree technique. Starting at the first vowel of the word, each successive character in the word is analyzed to see whether this character, in conjunction with the preceding characters, indicates anything definite about hyphen placement in the word.

If the character following an O is other than an M, the associated processing routine may indicate that a third character needs to be analyzed. This branching process continues until the end of the word is reached, at which time all the hyphen points in the word will have been found. This technique is, in effect, a type of dictionary lookup that attempts to pinpoint common characteristics of character strings without looking at the entire word. If this technique were flowcharted, the result would be very similar to a tree with its many branches.

An important algorithmic method of hyphenation is based on the analysis of the probability that a hyphen point will occur before, between, or after consecutive two-character combinations comprising the word. Using a large correctly hyphenated dictionary as the data base, the probabilities are determined by dividing the total number of times that the two-letter combinations occur in all the words with a hyphen point between them by the total number of times that the two-letter combinations occur in the word regardless of whether a hyphen point separates them or not. The probabilities themselves are stored in large tables. The algorithm steps across the word two characters at a time, using the probability for each possible hyphen point in the word.

A more detailed description of this method may be helpful at this point. Consider the word PROGRAM. The algorithm initially considers this word

to have six positions at which division points can occur:

P - R - O - G - R - A - M
1 2 3 4 5 6

Positions 1, 2, and 6 can be eliminated from consideration, since each syllable of the word must have at least one vowel in it, and if a hyphen were placed at any of these points, this condition would be violated. Hence, the analysis is limited to positions 3, 4, and 5.

Hyphenation accuracy and its effects.

The goal of composition people today seems to be 99 percent accuracy. On long-measure book work with today's programs, preliminary experience has indicated computers will hyphenate between one line in 100 and one line in 1,000. The former hyphenation rate coupled with even 99 percent acceptable accuracy would require resetting of two lines in 10,000. In a 400 page book, 40 lines per page, this would amount to resetting two to four lines.

The various approaches being taken today seem to be converging toward a combination system - a basic logic program supplemented by a small exception dictionary of words that cannot be broken properly by the rules. The dictionary area of the computer's memory would also have space provided for adding or revising words as the language changes.

Opinions differ, however, on how large the exception dictionary will have to be to achieve this goal. One manufacturer believes it can be reached with 2,000 words, while another maintains it requires 12,000 words. The final answer depends on several factors, such as the extent to which logic programs can be perfected and the varying needs of different composing rooms.

These varying needs are of special significance to book manufacturers today. Even with computer programmers specifying Webster's first choice with their 99 percent accuracy figures, other typographic standards may not be met adequately by these programs. Most of the work done to date has been done in newspapers; computer typesetting is only beginning on a large scale in book manufacturing. And newspaper quality requirements differ greatly from book requirements.

For instance, newspapers hyphenate proper names, a practice that may not be permissible in some books. The computer could be given a rule to avoid this - such as don't hyphenate words beginning with a capital letter - but this again takes more space in the computer's memory as well as slowing down operations.

Another instance is the breaking of words containing ligatures. Provision for hyphenating between characters forming ligatures is not included in many programs currently in use. Programming this requirement is more complex than a first glance would indicate.

FIVE-MINUTE TYPING TEST

Strokes

Without a doubt very few of us on entering the average modern business 71
establishment have ever stopped to consider the vital role played by records 148
in the successful operation of that business. To say that business as we 222
know it would not be possible without the use of records is certainly no 295
overstatement. 311

To say that we live in a world of records is a self-evident truth. 378
Our lives are bounded by them from the cradle to the grave. The progress of 455
civilization in the various countries of the world can be measured by the care 534
and completeness with which the experiences and discoveries of one generation 612
have been passed on to the next. Business records, naturally, have developed 690
to the highest degree in centers of commercial activities. 750

To the uninformed, "Keeping books" may be regarded as an activity of 819
recent origin and as being responsible for many of the hidden mysteries of 894
the business world. On the contrary, however, records are almost as old as 970
history itself. The crude characters scratched on the walls of the caves in 1047
which primitive man existed, the baked clay tablets in the Near East, or the 1124
papyrus rolls in Egypt tell us that since earliest times man has been confronted 1205
with the problems of recording what belongs to him, what is due him, and what 1283
he owes to his creditors in order that he may have some idea of his financial 1361
progress and status. In fact, only two years after Christopher Columbus made 1439
his way westward across the uncharted Atlantic Ocean, the first textbook in 1515
bookkeeping was written by an Italian monk. Those principles of keeping 1588
accounts by the double-entry system as developed in his book are basic to all 1667
our modern accounting records. 1697

9. Word processing

This section is included because it will probably require a book of its own someday. Word Processing is the new name for what we once knew as automatic typewriting. Almost daily, its application to the composition function becomes more defined.

If there is any trend that is developing in the composition input area it is that of "capturing keystrokes." at the point of origin. The concept is elementary: at the time someone starts to put an idea on paper capture some element of that process which can be used as input for typesetting. The word processor, whatever make, allows ideas to be typed at draft speeds without regard to errors. Corrections are made only in those areas that require correction. Thus a typist can produce manuscript copy more rapidly, and in addition to the typescript maintain some kind of record of that typing. Magnetic tape cassettes are the most popular form of record keeping since they can be used over and over again.

The point at which I first write the paragraph is the source documentation stage. I could be a reporter or an author or anyone who has ideas to generate and ultimately communicate. I would type this information as quickly as possible or dictate to a secretary who would do the same. Next I would go back and change or edit my original material (or the secretary would). I can change or insert new data because the machine has within it a flexible recording medium that permits this and the logic to allow it to be used effectively.

The advantages to anyone who sets type: less redundant keystrokes (don't forget that all typesetting material is actually keyed twice, once by the originator and then by the typesetter), easier correction of author's alterations and simple editing. All this is done without a computer. This chapter will attempt to deal with some of the concepts involved in word processing and some of the developments that could affect composition input.

Although our ultimate concern is with composition input this area is more clearly understood by first reviewing the concepts, techniques, and procedures used to create and prepare material for typesetting.

In essence, one takes an idea and through a series of steps, produces multiple copies in the form of books, newspapers, or other printed matter.

Creation of material

No matter what the material is, be it a letter, a textbook, a newspaper article, a magazine, or an advertisement, the starting point is the same: an idea in the mind of a person. To take this basic idea and create a useful document or manuscript involves two fundamental functions: the *creative* function, and the *corrective* function.

To start the cycle, an author creates a document containing his ideas. This may be handwritten; it may be typed in rough draft form; or it may even be in the form of dictation. The idea then passes to the corrective stage, where the idea is improved. The form of the improvement can be varied. It may be a simple spelling correction, it may be improvement of the grammar, or it may involve massive re-organization of the material with respect to sequence or content. The improvements are then sent back to the author for his reaction. The author may massage the material further and then pass it back to the corrective function for further improvement. It is entirely possible for material to go through this inter-active "loop" many times before the material is acceptable. It is also possible for the creative function (author) and the corrective function (editor) to be the same person. When both creative and corrective functions agree that the material is acceptable, it is then considered to be a good manuscript.

Depending upon the remainder of the system, the manuscript may be in one of two forms: (a) it can be a stack of typewritten pages, or (b) it can be in machine readable form such as magnetic or paper tape.

Processing of the material

Once the manuscript is informationally correct and in its final form, it crosses the line from "art" and moves into the field of "craft" where it begins the printing process.

Typewriting

The creation of a page eventually involves the use of a typewriter to put the authors' ideas on paper. Usually this is done at the very start, and the enrichment cycles involve a re-typing operation to incorporate the changes. Of course, any typewriter can be used to create correct pages, but our interest lies with those machines which have been designed to automate and improve the process.

Step 1

The manuscript, depending upon its form, is given to either a keyboard operator or a converter operator.

a) The keyboard operator simply keys the information onto punched paper tape. This tape contains both the textual content of the manuscript, plus the appropriate typesetter control commands for font style, indents, etc.

b) The converter operator loads the machine readable record on the input side of the converter, and produces a new tape that is capable of driving the typesetter. This tape contains both textual information, plus appropriate typesetter commands to control font style, indents, etc.

Step 2
The typesetting process takes the input tape and produces galleys. While the input tape contains the textual information and some typesetter commands such as font style and indents, the typesetter is typically adjusted to produce the desired line length, leading, etc.

Step 3

The make-up step takes the galleys produced by the typesetter and arranges this information to form a full page. In addition, all artwork, drawings, illustrations, etc, are added at this step.

Step 4

The full page, called "camera ready copy", is now passed on to the camera stage. A photograph is taken of the page, and a negative is made. In full color printing, a color separation process is used, and the original camera ready copy is photographed 4 times. A separate negative is made for each of the 4 colors to be printed, yellow, magenta, cyan, and black.

Step 5

The megative (or negatives) now go to a platemaking process, where photographically treated aluminum sheet is used to make a contact print of the negative. In full color printing 4 such aluminum contact prints would be made, one for each color used. This aluminum sheet is now the offset plate master.

Step 6

The offset plates are now loaded on the press, and the printing begins. In black and white printing, the paper need pass through the press only once. In color printing, the paper needs to pass through the press once for each color, or more practically, pass through a printing "head" for each color. Thus, full color offset presses are sometimes referred to as 2 head or 4 head presses. The output of the press is the finished product, and all that needs to be done is the appropriate folding, collating, stapling, or binding.

This is one example of the loop that begins with an idea and ends in such a way as to transmit that idea to others.

Basic automatic typewriters

Virtually every automatic typing system revolves around the use of an

electric office typewriter that has been equipped with the facility to accept electrical signals from the outside to activate typing, and to generate electrical signals as a by-product of typing. While the form of this capability varies greatly with manufacturer, these machines are commonly referred to as I/0 (Input/Output) typewriters. The I/O typewriter forms the main element of the system, and to the typewriter is added a recorder (usually a slow speed punched paper or magnetic tape device), a reader (again either magnetic tape or punched paper tape) and the neccssary control electronics. In principle, the typewriter will create a machine readable record as a by-product of typing, and it can read this record and produce page copy. Some systems can read tape, type, and produce new tape simultaneously, while other systems can only read and type, or type and record.

A number of different typewriters have been equipped with I/O features and used in automatic typing systems, but the most common machine for this application is the IBM Selectric, or Golf Ball typewriter. This machine operates at a printing speed of 15.5 characters per second, and offers the ability to quickly change character sets and/or styles by simply changing the ball. A number of type bar machines have also been offered with I/O features. Type bar machines usually operate at speeds of around 12 characters per second. While there are a number of differences between the Selectric typewriter and the type bar machines, the two essential ones are speed and code flexibility. The Selectric is a faster machine, but it has a rather rigid code structure. The type bar machines, while slower, offer far greater flexibility for utilizing different code sets.

Typewriter speeds are usually quoted in terms of characters per second, while typing speeds are quoted in terms of words per minute. Keyboarding speeds are quoted in characters (or keystrokes) per hour, while Keyboarding of newspaper material is quoted in terms of lines per hour. The table furnishes a quick cross reference to these different standards. By definition, a word is 5 characters plus space, or 6 characters. A newspaper line is commonly 30 characters.

The concept of power typing

Power typing is a term frequently used by IBM, and in principle is based on the fact that a girl can type faster when she does not have to worry about creating error-free page copy. A typical rough draft speed of a typist is 50-60 words per minute when trying to type error-free copy. Power typing involves giving this girl an automatic typing system that creates a machine readable record as a by-product of her rough draft typing. Further, the system permits the girl to back up and overstrike any typing errors she may make, and insert the correct information. This procedure also backs up the output tape, deleting the erroneous information and inserting the correct material. It is important to note that the desired output of this kind of system is a *good tape*; the page produced on the typewriter serves only to give the operator visibility as she types, and has no further value.

Once the tape has been produced, it can be handled one of two ways.

Stand alone system

In this case, the same girl that prepared the tape in a rough draft typing

Electric Typewriters
Adler
Facit
Hermes
IBM
Olivetti
Olympia
Remington
Royal
SCM

Automatic Typewriters
American Automatic Typewriter Co.
Auto-Typist
Metro-tel
Mate

"Automatic" Text Editing Device
(Stand-alone Work Stations)
IBM
MT/ST-II & IV
MC/ST

Itel
815
852
853

Ty-Data
3600/1
3600/2
3600/3

QuinnData
Quinn Type-70
Quinn Type-80

mode now re-inserts this tape into her typing system. The tape now produces clean page copy at the maximum speed of the typewriter. An example of this kind of process is as follows: suppose a girl were to type a 10,000 word document. By using rough draft typing, it will require 250 minutes (at 40 words per minute) to create a good tape of this information. The tape is then played back through the typing system, and it "power types" at a speed of 155 words per minute (IBM MT/ST), which takes an add minutes. The entire task has consumed 315 typing minutes, wheras the same task, done on a standard typewriter by the same girl, would require 667 minutes of typing time, at an average typing speed of 15 words per minute.

The basic concept of the stand alone system is to use the same machine for both rough draft typing and power typing.

Editype r
200

Redactron
1 card
2 cards
1 cassette
2 cassettes

Remington Rand
1 card
2 cards
1 cassette
2 cassettes

Centralized typing system

A slightly different set of circumstances surrounds the central typing application, where there may be many girls transcribing information from a central dictation source. These systems are commonly used by hospitals and large insurance offices. The first step in the process is for a girl to transcribe material in a rough draft typing mode. The good tape that is created by this process then migrates to a central playback system, where the tapes are power typed at a speed of 155 words per minute. In this situation, three girls power typing and one girl operating the playback system can produce the same amount of finished copy as 7 girls using standard typewriters. The basic concept of the centralized system is the use of different machines for each task.

Wang Laboratories
1210
1220

Multiple Work Station
Dedicated Computer Systems
Information Control Systems Inc.
Astrocomp
Edit Systems Inc.
Text-Ed

The use of a complete automatic typing system to produce good tapes in the centralized system is hard to justify, since the desired end result is a good tape and page is of no value, Opportunities exist for the application of a lower cost keyboard recorder, which produced good tape as the primary output but does not deny the operator visibility of her work.

Time Shared Text Editing
Bowne Time Sharing
Word/One
Other time sharing companies in U.S.

Word processing automatic typewriters

Automatic typewriter systems used for the creating and updating of typed pages perform the following functions:

CRT Stand Alone Devices
Spiras Division of USM Corp.
Accutext
Lexitron Corporation
Videotype

- create a machine readable record as a by-product of typing.

- permit re-creation of the correct portions of the copy by using this machine readable record to operate the typewriter

- permit corrections to be introduced in the proper place in the typed material, producing new page copy

- create a new machine readable record, containing the useful portions of the original material plus the additions.

There have been a number of companies that have produced automatic typing systems, including Facit, Tally, Smith Corona, and others. Of the lot, IBM, Dura and Friden survive as the largest suppliers of word processing

automatic typewriters. These three systems will be exposed in the following material.

Word processing typing systems are essentially automatic typing systems with some additional control features provided to simplify and improve the editing/revision tasks. The required control features are three:

1) Automatic carriage return. This is accomplished by using a "hot zone" right margin feature. The hot zone is determined by the setting of the right margin stop, and once the typewriter has typed to the right margin (or hot zone) a space code or hyphen code causes the carriage to return. This permits the operator to do some formatting of the typed copy by determining the line length of the finished page. The machine ignores any carriage return codes in the input tape, which eliminates the possibility of format problems due to carriage return codes being discarded with unwanted material in the input tape.

2) Discretionary and mandatory hyphens. Two kinds of hyphens are used in word processing typing systems. ***Discretionary*** hyphens are those that print only when they appear in the hot zone. As the original material is typed, the tape may contain a number of words that are broken by using discrectionary hyphens. When the page copy is reformatted, these words may not appear at the end of a line, and so the hyphen is redundant and is not printed. However, when one of these hyphens appears in the hot zone, it is printed, and it initiates a carriage return. ***Mandatory*** hyphens are those that print every time, regardless of their place in the line. Some word sequences, such as "mother-in-law", require hyphens to always be present. When a mandatory hyphen appears in the hot zone, it also initiates a carriage return. The two different hyphens carry two distinct codes; and word processing typing systems have two hyphen keys on the keyboard.

3) Programmed playback and stop. This feature permits the operator to select a certain amount of information to type, after which the machine will stop. Most machines offer some combination of character, word, line, sentence, or paragraph. In this way, the operator can instruct the machine to type only a specific portion of the material, which permits additions or corrections to be inserted in the desired spot.

The logic element controls the operation of the entire system, and this operation is based on commands from the control panel, or even from command codes that appear in the input tape. For example, when two readers are being used in a "tape merge" mode, transfer codes in the input tapes will shift the input from one reader to the other. Other codes that can be in the input tape are "punch off" (where the material is to be typed, but not copied), etc. The word processor element determines how much material will be printed before the machine stops (character, word, sentence, etc.). The example given above uses paper tape terminology, but the same principles apply to magnetic tape systems.

IBM MT/ST (Magnetic Tape Selectric Typewriter)

This is the most well known of all the automatic typing systems. The heart of

the system is the IBM Selectric typewriter, to which is attached either one or two magnetic tape stations. Each station is capable of either reading information into the typewriter or recording material from the typewriter. The logic in the machine permits the playback to stop after each character, word, or line. The logic also searches for a given line number in the tape, and the search speed is 900 characters per second. In addition, the two station configuration can "merge" tapes, which combines portions of two input tapes to form a page copy. One of the tapes can serve as a program tape to determine format, and the other tape serves as the material input tape. The magnetic cartridges use special edge-sprocketed magnetic tape, very similar in appearance to 16 mm motion picture film. The cartridges hold up to 100 feet of tape, which will store 24,000 characters, at a price of about $20 each. Cartridges with less tape are available for $12 each. The cartridges are self threading, and re-usable many times.

IBM MC/ST (Magnetic Card Selectric Typewriter)

A recent addition to the IBM automatic typing system line is the MC/ST. While essentially the same as the MT/ST in principle, it differs in one important aspect. The media used is a special magnetic card, which can store 5000 characters arranged in 50 tracks of 100 characters each. Each card typically contains a full page of typed information. The MC/ST uses a single record/replay station, and handles a single card at a time. The card is re-usable many times, and cards cost about $1 each.

The significant difference between the MT/ST and the MC/ST is the concept of updating. The MT/ST reads an input tape, and creates a new output tape which contains all the valid material from the original tape plus any additions or corrections. The MC/ST reads the input card, and any changes or additions are made on that same card, thus in effect updating the original card. It's obvious that the MC/ST is therefore limited in the amount of new information that can be added, while the MT/ST can accept virtually any amount of new material. The MT/ST is basically an editing system, while the MC/ST is aimed at the concept of single station power typing.

Dura

The punched tape equivalent of the MT/ST is the Dura 1041 equipped with word processor. The heart of the machine is the IBM Selectric I/O typewriter, to which is connected a slow speed paper tape reader and punch. The word processor feature permits the playback to occur a word, sentence, or paragraph at a time. In addition, a single step key furnishes the character at a time playback. The concept is to read an input tape, insert corrections or additional information, and create a new output tape as a result. The machine can also be equipped with an additional reader, which permits merging of information from two tapes. An additional option permits the use of a slave printer, which then makes a powerful system for the mass preparation of personalized letters. The primary input reader contains the letter text, and the auxiliary reader contains all the names and address. The main printer types the letter, and the auxiliary printer types the mailing envelope at the same time the inside address is typed on the letter. In addition to handling punched paper tape, the machine can be equipped to handle edge punched cards, either singly or in fan fold strips.

The Friden machine has been around for a number of years, having started out in life as an I/O device for small computers. The heart of the system is the Friden type bar I/O typewriter, which was originally designed and manufactured by IBM as their model A typewriter. The typewriter is used in conjunction with a Friden slow speed paper tape punch and reader, and in concept is virtually identical to the Dura 1041. The word processer of the Flexowriter is based on playback of a character, word, or sentence at a time. Like Dura, the Friden can be equipped with a second reader, which permits some merging-of input information. The Friden also handles edge punched cards.

4) *Computer managed typing systems*

A number of companies are now offering typing systems which address the very same problem as the word processing systems such as the MT/ST; however, they utilize a minicomputer as the basic control element. Most of these systems are designed to furnish a good typed page as the primary output, and options are available to furnish either paper or magnetic tape as well. The computer, in addition to controlling the typing of the manuscript information, can also be used to perform "pre-processing" of the material, thus organizing the typed material so that the resultant output tape can be fed directly into a data processing or typesetting system.

A computer managed system is the ASTROTYPE, offered by Information Control Systems.

The system consists of up to four Selectric I/O typewriters, connected to the computer. Up to four DEC-TAPE magnetic tape units are connected to the output of the computer, in effect giving one tape unit for each typewriter, under computer control. In use, the operator types material at rough draft speeds (power typing), and the information is captured on magnetic tape. The computer automatically assigns line numbers to each line as the operator types. The page copy then passes on to the edit function, where appropriate notations are made relative to the portions of the text that must be changed. The page copy comes back to the operator, and now she merely loads the matching tape, and uses the typewriter to make statements concerning the action to be taken. The operator types in the number of the line in question, and then tells the computer what must be done (remove a word, change a word, change a letter). The computer makes the requested change, and types out the line for the operator to visually verify. The operator must acknowledge that the revision is correct, and it then becomes part of the mag tape record. When all the corrections, additions, or revisions have been done, the operator calls for a print out of the final page. The computer then generates the page copy at the rate of 155 words per minute. The magnetic tape record of the page is stored until the next revision is required, or until the tape is erased.

The computer can also do some formatting of the page, such as changing line lengths, and justifying both margins by interword spacing. The computer can also remove a paragraph from one section of the page and re-insert it elsewhere on the page, or it can be inserted on another page.

The system is available in a number of configurations. It can be equipped

with a line printer, or it can also be furnished with an output of either magnetic or punched paper tape. The basic system consists of the computer (DEC PDP-8), and one typing terminal. To this may be added typing terminals (up to a maximum of 4 terminals). The system also offers the line printer.

A somewhat different system is the Varitext, offered by Varian.

The system can be used with up to eight typing stations. The typing station is an IBM Selectric typewriter, modified by Varian to hold two tape cassettes of the Philips/Norelco style. In operation, the operator uses the KSR 33 Teletype machine to instruct the system as to the task to be done. Then, the typing station operators type information in a power typing mode, recording the information on the cassette in the typewriter. When the page (or pages) have been completed, the typing station reads this cassette to the computer, and the computer assigns line numbers and prints the information on a high speed line printer. The line printer output is then passed to the edit function, where correctional notations are made relative to the changes required. The page then returns to the typist, who finds the matching cassette and loads it in the typewriter, along with a blank cassette. The typist states the line number in question, and the computer controls the cassettes in the terminal to copy all the good information from the original cassette to the new one, stopping at the desired line. The typist enters the correct information, which is recorded on the second cassette. The typist states the next line, and the process is repeated until all corrections have been made. When the new cassette is completed, it can be read to the computer for a new page print out (either with or without line numbers) or the same cassette can drive the typing terminal to generate page copy. This system also offers either an IBM compatible mag tape output, or a high speed paper tape punch.

A still different system is one using a time sharing terminal, such as the IBM 2741 or the Datel. These are typing terminals that can be connected to a large central computer by means of telephone lines. The concept was originated by IBM, woo offered their ATS (Administrative Terminal System for data text) through their Service Bur~~eau~~ Corporation. Several companies offer versions of the service, among them VIP Systems in Washington DC.

The typing terminal is an IBM Selectric I/O Typewriter with some electronics. When not connected to the computer, it operates just like an office typewriter. In use, the operator connects the terminal to the computer by daking a telephone call. As information is being typed, it is also being stored at the computer. The computer automatically numbers lines. Thus, the page copy is with the operator and the stored information is with the computer. The page copy is passed to the edit function, and notations relative to corrections are made. This page then comes back to the operator, who re-connects the terminal to the computer, types in the in the address of the information so the computer can retreive it from memory, and then states the corrections that must be made by using line numbers to pinpoint areas of interest. The computer makes the corrections, and when all corrections are complete, the operator can call for a print out of the updated information. Since the central computer is usually large (such as the IBM 360/65) it is possible for a fully formatted magnetic tape to be made of the material.

Typing terminals are available from a number of sources, and Dura makes a version of the 1041 typing system for this use. In the case of Dura, the machine is furnished with a paper tape reader and punch, so that in addition to the operator having page copy she also retains a paper tape record of the material.

The rate structure for time sharing varies with the company. In general, the charges are some combination of the following. The prices shown are those quoted by one service bureau.

Typing terminal model 2741	$100 per month
Connect time	$ 11 per hour
CPU time	15¢ per second

The CPU time rate is usually governed by the size of the core resident in the computer. The larger the core size, the higher the rate. In addition, it is possible to leave information stored with the central computer.

The systems presented in this section have all been based on the principle that the primary output is a good page ; the good tape is secondary. There are a few systems (such as the Astrocomp) that are based on the converse, that is, the good tape is the primary output, the page is secondary. There are other systems that take this point a step further, and provide a good tape but no printed output. As a general rule, these systems do not live in both the world of creation and the world of typesetting.

The typesetting function

The typesetting function embraces the combination of two different types of information

the text .... what does it say?
the format ... how does it look?

Virtually every typesetting device requires that the format control information be interspersed with the text material. For our purposes, all typesetting tasks will be placed in one of the three following catagories, depending upon the amount of format control information required

1) Straight matter or text . . . doesn't require much format control

2) Display/advertising material . . . takes a fair amount of format control

3) Textbooks and special problems . . . takes a lot of format control

It's obvious that the actual procedure in any given case will be determined by such things as

— the type, and capability of, the typesetting system being used

— the form of the input data

— the output desired

Straight matter or text

Straight matter is best illustrated by using a newspaper or paper back book as an example. The task is to typeset large volumes of material, and the material is simple in format and uses only a few basic fonts. Straight matter typesetters usually contain two magazines (each with two rail choices) and the magazines are loaded with different size fonts, such as 6 point and 10 point. The type styles used are fairly common, such as Bodoni, Garamond, or News Gothic. The rail choices furnish bold face or italic. The format is generally consistent, and doesn't change often. Newspapers use a standard 11 pica line for news columns, with front page or editorial columns going to 15 or 20 pica line lengths. Paper back books are usually around 22 pica line lengths.

Straight matter tasks can be handled by OCR, or by direct reading of tapes produced by Dura or Friden or other machines. However, two things must be done to satisfy the requirements of the typesetting machine:

1) The codes must usually be converted, since computer codes are not normally compatible with most straight matter typesetters.

2) The textual matter must be combined with typesetter commands to achieve formatting of the material.

OCR systems usually require two passes at the material before it is ready to go to the typesetter. The first pass is ***interpretive,*** where the pages are read and converted to machine readable tape, with the output being either 7 or 9 track IBM magnetic tape format, or 8 level punched paper tape. OCRsystems can read special character sequences which are interpreted as command codes. Since only a limited number of characters exist on a typewriter, it is necessary to combine codes to create command sequences.In this way, the "$" followed by some non-digit such as a letter or a punctuation mark can be inserted on the page copy to stand for Quad center, or Upper Rail. During the interpretive pass, this code sequence is simply converted to a discrete 8 bit code. The second pass is the ***translative*** operation, where the computer compatible tape is read into the system and a typesetter format tape is generated. Most straight matter typesetters require 6 level TTS tape for input, and in addition, command sequences frequently take 2 or more codes. The translative pass generates the proper 6 level code for the textual characters, and "explodes" the 8 level single character into the appropriate string of 6 level characters for functions. Some of the larger OCRsystems have sufficient computer capacity to accomplish both the interpretive and translative functions in a single pass, however the smaller machines based on the PDP-8 or the Varian generally require two passes.

Classified ads

Newspapers, of course, have requirements in excess of simple straight matter problems. Such things as classified advertising and display matter are also routinely done, however in virtually all cases, the tapes to drive the typesetters are produced on keyboards (as opposed to any OCR type system). The keyboard produced tapes are non-justified, however there is seldom any implication of line measure, since any line keyed is less than the

line measure being used. For example, most classified ad columns are 9 picas, and provided the material keyed does not exceed 9 picas on any line, there is no line end decision necessary.

Display typesetting

Newspapers, as well as magazines, use advertising and display copy throughout their publications. The task is to create eyecatching copy, arranged in a well balanced aesthetically pleasing manner. This kind of material combines a variety of different font sizes, font styles, line lenghts, photographs, and special logos.

Essentially, there are two ways to accomplish this kind of composition.

Paste up

The most common traditional method. In this procedure, all the elements of the material are typeset separately. For instance, all the 5 point material is keyed and typeset, then all the 8 point material is keyed and typeset, and so on. When all the pieces are complete, the ad is assembled in a make up function. The various textual elements are cut and pasted in their proper places and at the same time illustrations and photographs are inserted (in the form of halftones). Large type is usually typeset on a display or headline machine, such as the CG 7200 or the VGC Phototypositor.

Compose

This procedure involves the use of a phototypesetter (or more properly, photocomposer) that can typeset a wide variety of font sizes, and styles on a single piece of film or paper. A number of machines are available today, starting with expanded machines such as the CG ACM9000 and ending with the high speed high cost CRT systems. Machines such as the Merganthaler Super-Quick can hold 8 fonts in sizes from 5 to 72 points. The Photon 713-5 holds 4 fonts, in sizes from 5 to 36 points. Some machines of this class offer such features as "reverse leading", where the film or paper can be "advanced" in either direction to shift the baseline position of the desired character. Obviously, these additional features greatly complicate the keyboarding task, since the typesetter control is much more complex. As an example, a straight matter machine may require 1 or 2 characters to shift from one font to the other (upper magazine to lower magazine), while a font change command on a photocomposer may require a code sequence of up to 10 characters. Photocomposers usually require justified tape as an input, which further complicates the keying task when changing font sizes.

The choice of method (i.e., keyboard and typeset vs paste-up) is usually made by the mark-up or layout man. To adequately instruct the keyboard operator he must write down each and every step of the keying process necessary. Obviously, if the copy to be set is very complex, it may take him longer to figure out the keyboarding procedure than it would take to compose the material using cut and paste techniques. On the other hand, he may know that a certain keyboard operator is very skilled at that particular kind of keyboarding task, so he will make the decision to have it keyboarded. The actual decision is subjective, and is influenced by a number

of factors that are subject to change, such as the set up of the typesetter at that moment, the number of skilled keyboard operators available, et al.

In general, there are three ways to create the tape required to drive these photocomposers:

Counting keyboards

In this method, a counting keyboard is used. The keyboard is adjusted for the desired line length, and an indicator on the keyboard tells the operator how much space is left in the line as the keying is done. Where font changes are necessary, the keyboard operator uses a "look up table" that furnishes the character sequence necessary to do the task. These counting keyboards usually have 2 or more width plugs "on line", to facilitate the use of fonts with different width values. Counting values can be selected by a single keystroke. These keyboards are available in either blind or hard copy versions.

Stored format keyboard

The Automix 710 machine is the primary example of a counting keyboard with format storage. The 710 is a typewriter based system, which contains 6 programmable "magazines", and each magazine can be independently adjusted for a full set of criteria: font size , font style, line length, leading, space band value, etc.. The operator then uses a single keystroke, calls up the command sequence and inserts it in the output tape automatically. With this system, the operator need concentrate only the text, since all the complex routines are electronically generated.

Computer systems

These systems are extensions of the basic hyphenation-justification computers used with straight matter machines. The role of the computer has expanded to embrace photocomposer commands, in addition to the simple line measure task. In a computer system, the photocomposer control sequences are resident in memory. At the time of keyboarding, the keyboard operator would insert an address string of up to 9 characters in the tape. When this unjustified tape was read into the computer, the address string would cause the computer to insert the entire photocomposer control sequence in the resultant output tape. Since the composer command sequence could be as many as 20 characters, this saved the keyboard operator a significant number of keystrokes, as well as reducing the likelihood of errors. These also meant that virtually any keyboard, be it blind or hard copy, counting or non-counting could be used to prepare input tapes for computer systems. All that was necessary was the appropriate look table to inform the keyboard operator of the address string required.

This computer implication did give rise to a family of keyboards that are specifically tailored for computer input. These keyboards offer an auxilary keyboard that generates a number of fixed code strings, or addresses, that can be called by a single keystroke. The code strings are usually factory wired, and as such are for use with a specific computer, such as the IBM 1130 or the PDP-8 These keyboards are available in either blind or hard copy versions.

Textbooks and special problems

The most complex kind of typesetting usually revolves around the preparation of textbooks, such as mathematics or languages.

This type of work uses a wide number of special symbols, in addition to both light and bold face, and italic, typefaces. In addition, material can appear on different baselines, for both superscript and subscript notation. Typesetters used in text material composition are usually selected for their ability to

— furnish adequate symbols

— furnish adequate fonts

— furnish adequate sizes of both symbols and fonts

— be able to use multiple baselines

Symbols

The most important aspect. The special symbols are usually grouped together on "pi" grids on phototypesetters, and on a special "pi" ball for MT/SC systems. Some phototypesetters furnish standard grids with a variety of pi characters on the grid. Pi grids are selected for the job at hand, to address the unique symbols required. For example, mathematics requires a comprehensive set of special symbols, as does chemistry. Usually the superscript and subscript characters are furnished on the main grid, or ball, which reduces the necessity of shifting baselines.

The typesetting of music also requires a large symbol set.

Fonts

Almost any typesetter can furnish adequate fonts for English language work, however some foreign languages strain the limits of the most sophisticated typesetters. In addition to requiring a very large number of symbols, often times the text is set in a different orientation, for example Japanese is set from the bottom of the page to the top, and Hebrew and Arabic are set right to left. Arabic is perhaps the most complex of all foreign languages to set, since not only are there a large number of symbols, but the characters are linked, similar to handwriting.

Sizes

In general, phototypesetters or composers can easily achieve the desired size by choosing the right lens. The MT/SC has difficulty with large characters, and in some cases (such as when printing the mathematical integral symbol) the MT/SC may print the upper half with one impression, and the lower half with another impression. Size is probably the easiest problem to overcome when printing complex material.

Baselines

Most typesetters set material on one baseline at a time, and the paper can be

incremented in one direction only. This means that material must be set on the highest baseline first, starting at the top of the page. The characters that are to be set appear in the center of the page or on the right, then the carriage of the phototypesetter must be moved over to the precise spot, the character set, and then the carriage returned and the paper advanced to the next baseline. This involves some very complex keying routines when using phototypesetters, although some phototypesetters offer reverse leading. To set a superscript symbol, the paper is simply incremented down the required number of points, and the symbol flashed. Then, the paper is incremented back to the normal baseline, and setting continues. The reverse procedure is followed when setting subscripts. The reverse leading feature greatly simplifies this multiple baseline task.

In practice, the easiest machine to use for complex typesetting is a Selectric Composer or a Varityper, simply because it has visibility and an operator can monitor the procedure and make the necessary judgements. By using Varityper for example, the setting of superscript or subscript is very simple: when the operator reaches the point requiring the change of a baseline, she simply rolls the platen up or down the required distance, and sets the character. This is far easier than programming a phototypesetter to perform the precise steps necessary. Generally complex material is set by specialty houses, and they are equipped with all the necessary hardware to do this kind of typesetting on a production basis. Where smaller commercial printers have occasion to do this kind of work on a now and then basis, they use either the Selectric Composer or Varityper, or use cut and paste techniques.

Directory of Word Processing Companies

American Automatic Typewriter Co.
2323 N. Pulaski Rd.
Chicago, Ill. 60639
(312) 384-5151

American Automatic Typewriter Co. is a privately held corporation that has been manufacturing and marketing "Auto-typist" products for over 30 years. The basic line of products is designed for the production of form or standard clause correspondence. Direct sales and service organizations exist in New York City and Chicago, with dealers representing Auto-typist in most sections of the United States.

Bowne Time Sharing Inc.
345 Hudson St.
New York, N.Y. 10014
(212) 989-6006

Bowne Time Sharing Inc. is a subsidiary of Bowne & Co., a large financial printer. "Word/One," Bowne's basic service, is marketed in New York, Boston, Washington, D.C., Philadelphia and Chicago. Through an

arrangement with Pacific International Computer Corp., the service is also available in San Francisco and Los Angeles. In addition to Word/One, BTS provides "Photo Comp," a service that allows Word/One material to be photo-composed.

Edit Systems Inc.
19959 Vernier Rd.
Harper Woods, Mich. 48225
(313) 886-6545

Edit Systems Inc. provides a shared logic in-house word processing system called "Text-Ed." The system utilizes a PDP-8 mini-computer, which supports Selectric terminals and has a high speed printer. Branch offices are located in Detroit, Washington D.C., and New York City.

The Edityper Corp. (a Division of Epsco Inc.)
1335 Rockville Pike
Rockville, Md. 20852
(301) 424-3997

Epsco Inc. manufactures control systems, data products, and general electronics. The Edityper Corp. designs and manufactures word processing equipment. Its manufacturing facilities are located in Westwood, Mass. In November, 1971, Terminal Equipment Corp. announced agreement with Epsco to purchase Edityper Corp. Edityper's products are marketed by Word Processing Products, Inc., an independent sales and service organization. WPPI has offices in Philadelphia, Hagerstown, Md. and Rockville, Md.

Information Control Systems Inc.
313 N. 1st St.
Ann Arbor, Mich.
(313) 761-1600

ICS is in business with a product known as "AstroComp." AstroComp utilizes a PDP-8 mini-computer and can support up to 8 Selectric terminals. A high speed printer is available with the system. Branch offices are located in Wilton, Conn., and Chicago to serve the New York and Chicago metropolitan area markets, respectively. Sales representatives also cover St. Louis, Boston and Washington, D.C.

International Business Machines Corp.
Office Products Division (OPD) Parsons Pond Drive
Franklin Lakes, N.J. 07417
(201) 848-1900

There are about 200 OPD sales and service offices throughout the United States. IBM-OPD provides extensive systems and customer support. The company also runs a training school (one week) for word processing center supervisors in Dallas, Tex.

Itel Information Products Corp.
(A wholly owned subsidiary of Itel Corp.)
2585 East Bayshore
Palo Alto, Calif. 94303
(415) 328-5660

A network of about 20 branches offices covering 30 cities and about 30 dealer organizations serving 44 cities gives Itel coverage of the major portion of the U.S. marketplace. Itel's field force is second only to IBM in word processing.

Lexitron Corp.
(Formerly Autoscribe Co.)
413 Moss
Burbank, Calif. 91502
(213) 843-5111

Lexitron builds a uniquely designed CRT display editing device. As yet, the company has not installed systems, but has announced orders in excess of $500,000.

Metro-Tel Corp.
409 Railroad Ave.
Westbury, N.Y. 11590
(516) 333-7650

Metro-Tel manufactures telecommunications equipment and automatic typing equipment. Its Mate automatic typing equipment utilizes a baseplate that connects to most standard electrics and uses roll paper as the recording medium. This equipment is used primarily for form letter writing. Metro-Tel recently introduced Model 801, a magnetic tape cassette unit designed for more complete word processing applications.

QuinData Inc.
(A division of Quindar Electronics Inc.)
60 Faden Rd.
Springfield, M.J. 07081
(201) 379-7400

Quindar Electronics Inc. is an electronics company that manufactures advanced solid state equipment for use on data transmission, supervisory control, computer-based control and/or data acquisition systems. Quin Data Inc. designs, manufactures, markets and services word processing products. Manufacturing facilities are in Springfield, N.J. and Toronto, Ont.

Redactron Corp.
100 Parkway Drive S.
Hauppauge, N.Y. 11787
(516) 543-8700

Redactron was organized in 1969 to develop and manufacture WP equipment. The company is presently producing both single and dual magnetic cassette and magnetic card WP devices.

Remington Rand
(A division of Sperry Rand)
P.O. Box 1000
Blue Bell, Pa. 19422
(215) 646-9000

As a leading manufacturer and marketer of office machines, Remington Rand has recently completed arrangements with Redactron Corp. to market their line of cassette and card word processing equipment. It is expected that Remington Rand will not substantially alter the basic Redactron product at the outset.

Spiras Systems, Inc.
332 Second Ave.
Waltham, Mass. 02154
(617) 891-7300

Spiras Systems is a subsidiary of USM Corp. Spiras is a producer of mini-computers, CRT terminals and a CRT word processing unit known as "Accutext." Presently, all of Spiras' activities are located at headquarters in Waltham.

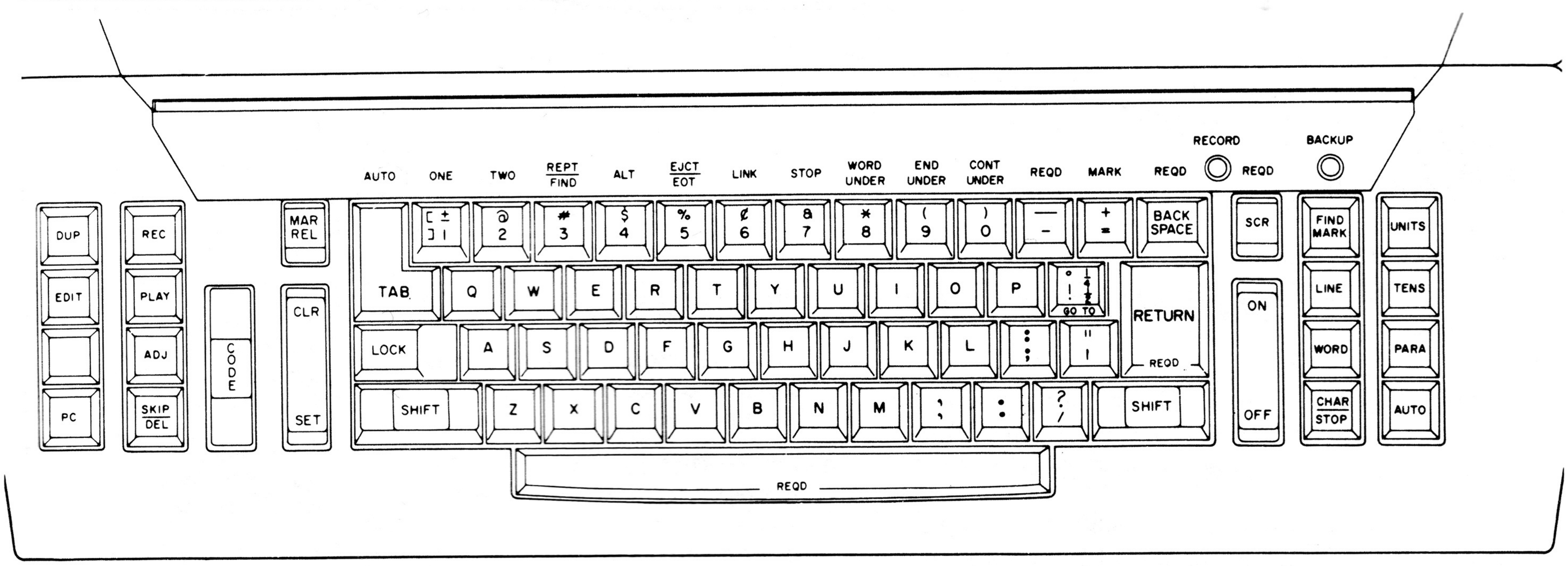
Ty-Data Inc.
109 Northeastern Blvd.
P.O. Box 841
Nashua, N.H. 03060
(603) 889-1155

Ty-Data has been manufacturing and distributing its 3600 series of magnetic tape cassette word processors since early 1971. The dual cassette Model 3600/2 was introduced in October 1971. A three cassette system is expected by year end. Over 100 units of the one cassette model 3600/1 are in the field.

Wang Laboratories Inc.
836 North St.
Tewksbury, Mass. 01876
(617) 851-7311

Wang is the largest United States manufacturer of electronic calculators. Its initial WP product entries — the Model 1210 single casette typewriter and Model 1220 dual cassette typewriter — combine Wang's expertise in cassette, typewriter and computer technology. The 1210 and 1220 were introduced in late October, 1971.

The following four pages describe the operating procedures for the Redactron word processing system. Much of the information presented is common to other systems of its type.



GROUP 1.
KEYS DEFINING BASIC OPERATIONS.

Basic operations are something like those in a tape recorder or dictating equipment. They are indicated in our Group 1, at the left of the keyboard. We are talking about them in an order that is logical to the person using the machine, not the order in which you see them on the machine.

They indicate the following modes:

a. Record. Original recording of typewritten information. This takes place on the magnetic medium (tape or card) as well as on paper.

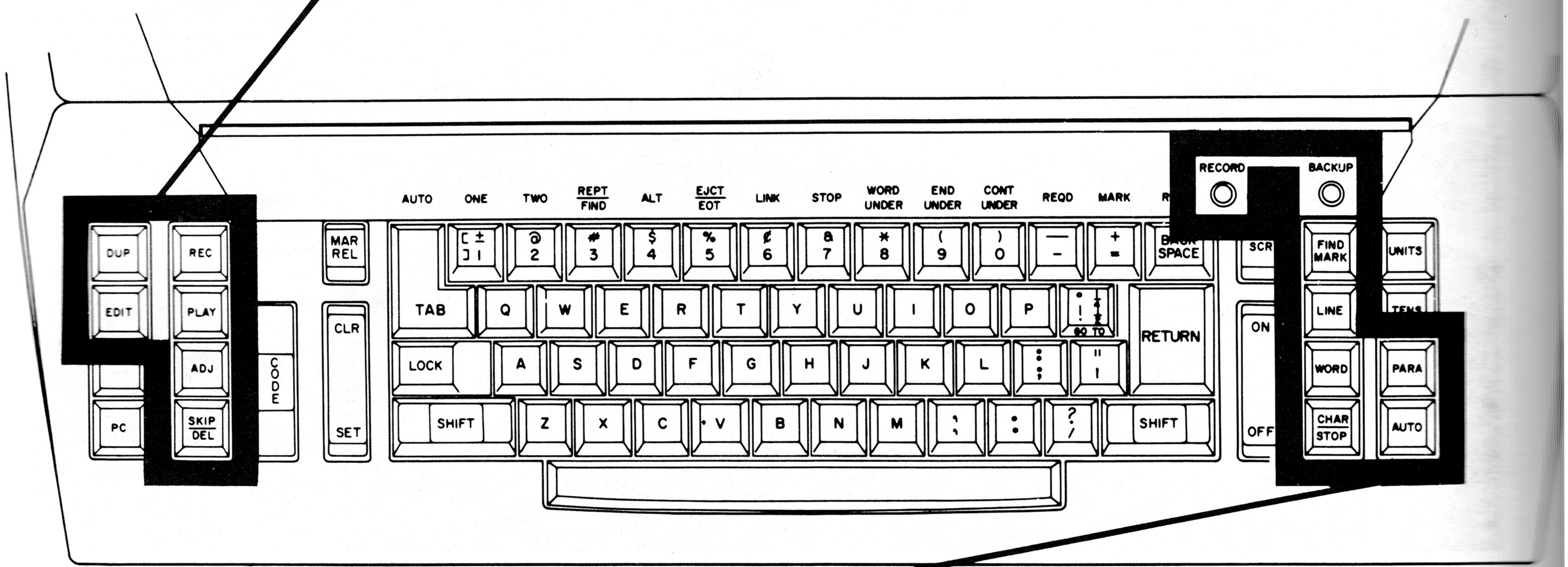
b. Playback. Material stored on magnetic tapes or cards is typed automatically on paper. "Playback" can be stopped, and extra material added to the paper, then started again. The extra material on the paper is not stored, however.

c. Adjust. This is like playback, but automatically adjusts the right-hand margin while playing.

d. Duplicate. This is operative only in two-cassette or two-card editing typewriters. Information on one cassette or card is transferred to the other at very high speed, without printing on paper.

e. Edit. This is like playback, but when printing is stopped, the operator can type in new material, which is then part of the magnetic record as well as appearing on the paper.

f. Skip/Delete. This, too, is a kind of playback. "Skip" is used with "play" or "adjust" to bypass material on the tape or card — that is, not print it. But the skipped material stays on the tape or card. When "skip" is used with "edit", however, ("editing" being another word for correcting), the material is actually deleted or removed from the tape or card.



GROUP 2.
ACTION KEYS.

They start the tape or card in motion and define where the action stops. You can think of them also as positioning keys.

—When the basic operation is "record", the action keys in the row under the reverse light cause the tape or card to back up to the specified position.

—When the basic operation is "playback", "adjust", "edit" or "skip", the tape or card will go forward.

—When "edit" is the basic operation, and the "record" button is depressed, the keyboard will lock and the operator may go back by depressing a suitable action button.

a. Character/stop. The machine stops at the next character. Forward or reverse.

b. Word. The machine stops after the next detected space forward. When backing up for correction it stops at the first letter of the word just passed.

c. Line. The machine stops at the next carrier return in forward. When backing up, it reverses one physical block.

d. Find Mark. The machine stops at the designated "mark". In the tape machine, the "mark" is the typist's notation to herself about a place where she wants a stop. Marks may be "counted" by the machine so that they can be returned to by number, at very high speed. Forward or reverse.

In the card machine, "mark" sends you back to the beginning of the card.

e. Para(graph). The machine (going forward only) stops at the beginning of the next paragraph.

f. Auto. The machine types forward and stops at the next "stop" character.

ROUP 3.
EYS FOR SPECIFIC INSTRUCTIONS
O THE SYSTEM (CONTROLS).

ne keys that are control keys are all regular type-riter keys as well. To function as specific instruc-ons to the machine, the "Code" key has to be ıshed along with the regular typewriter key. Most of ese keys' additional jobs are indicated on a horizon-l bezel above the keyboard.

ontrol characters are recorded as single special naracters on the tape or card. If it is desired that they int, as well, the print control switch (labeled PC) at wer left is switched on. The character then prints ith a slash on it like this: 2 (The slash of course, dicates that this is an instruction code, not the rdinary typing function.)

he control keys are divided into two sets: the keys e know as format keys (that is, ones we ordinarily se, like spaces, backspaces, carrier returns); and the eys we know as number and symbol keys – the top ne of the typewriter.

Taking the formal format keys first, and from the bottom up:

a. Required space (/). This is a space that must be considered a graphic character. It inserts spaces between words that must be on the same line, as, for example, in a date, June 22, 1971.

b. Required carrier return (RCR). This means that the carrier return signal can't be eliminated in "adjust". This might be used for the three or four-line address on the top of a letter.

c. Required special carrier return (SCR). Like the required carrier return, but the line is not recorded. Used during 1-card, edit, where it is desirable to get a lot of information on the card, but where the width of the line will be narrower on the paper.

d. Required backspace (←). This is needed to make characters not on the standard keyboard, as for example, the accents over e in some languages.

e. Automatic tab. The typewriter will automatically execute that tab after every carrier return. "Required carrier return" discontinues automatic tab.

Now, taking the character keys that normally serve graphic functions:

a. The (=) is recorded as (≠) Mark. This is used for separating blocks of material.

b. The (-) becomes a required hyphen (/) when coded. A required hyphen is part of a word that cannot be eliminated if it is run together (unlike a regular hyphen at the end of a line, but in the middle of a word). Example: son-in-law.

c. The (0) is for starting continuous underlining in groups of words.

d. The (9) is for "end underline", meaning stop the underline.

e. The (8) is for starting word by word underlining.

f. The (7) is a Stop code, stopping the machine during playback and edit when Auto action is used.

g. The (6) is a character called Link that defines the end of a block without generating a Carrier Return. If it is used with the Special Carrier Return, it permits cramming the magnetic medium with data that will print in the designated format.

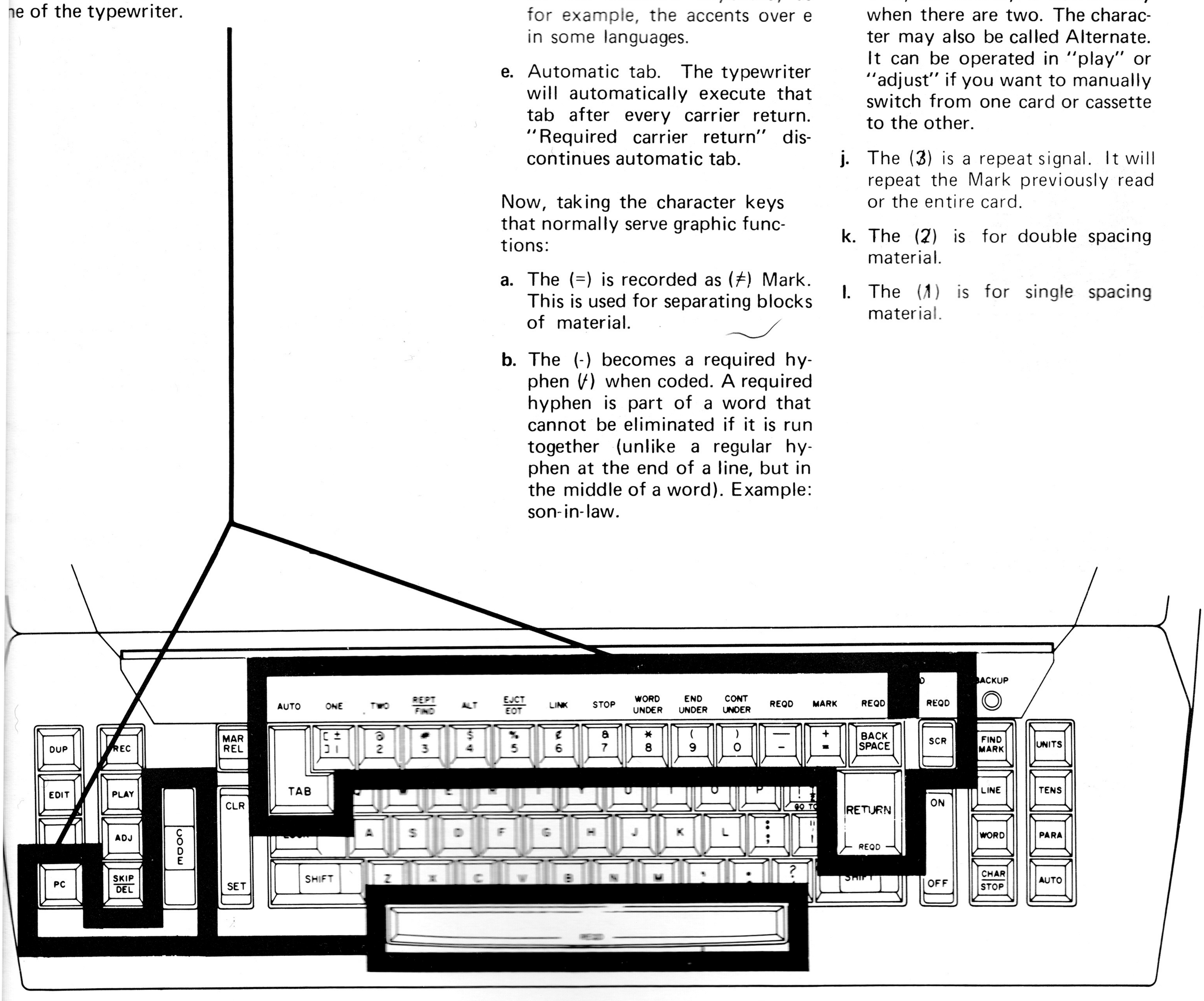
h. The (5) is an "end of tape" (EOT) code, for the tape machine. On the card machine, it means eject card.

i. The (4) activates switching from one card or cassette to the other. This, of course, is useful only when there are two. The character may also be called Alternate. It can be operated in "play" or "adjust" if you want to manually switch from one card or cassette to the other.

j. The (3) is a repeat signal. It will repeat the Mark previously read or the entire card.

k. The (2) is for double spacing material.

l. The (1) is for single spacing material.



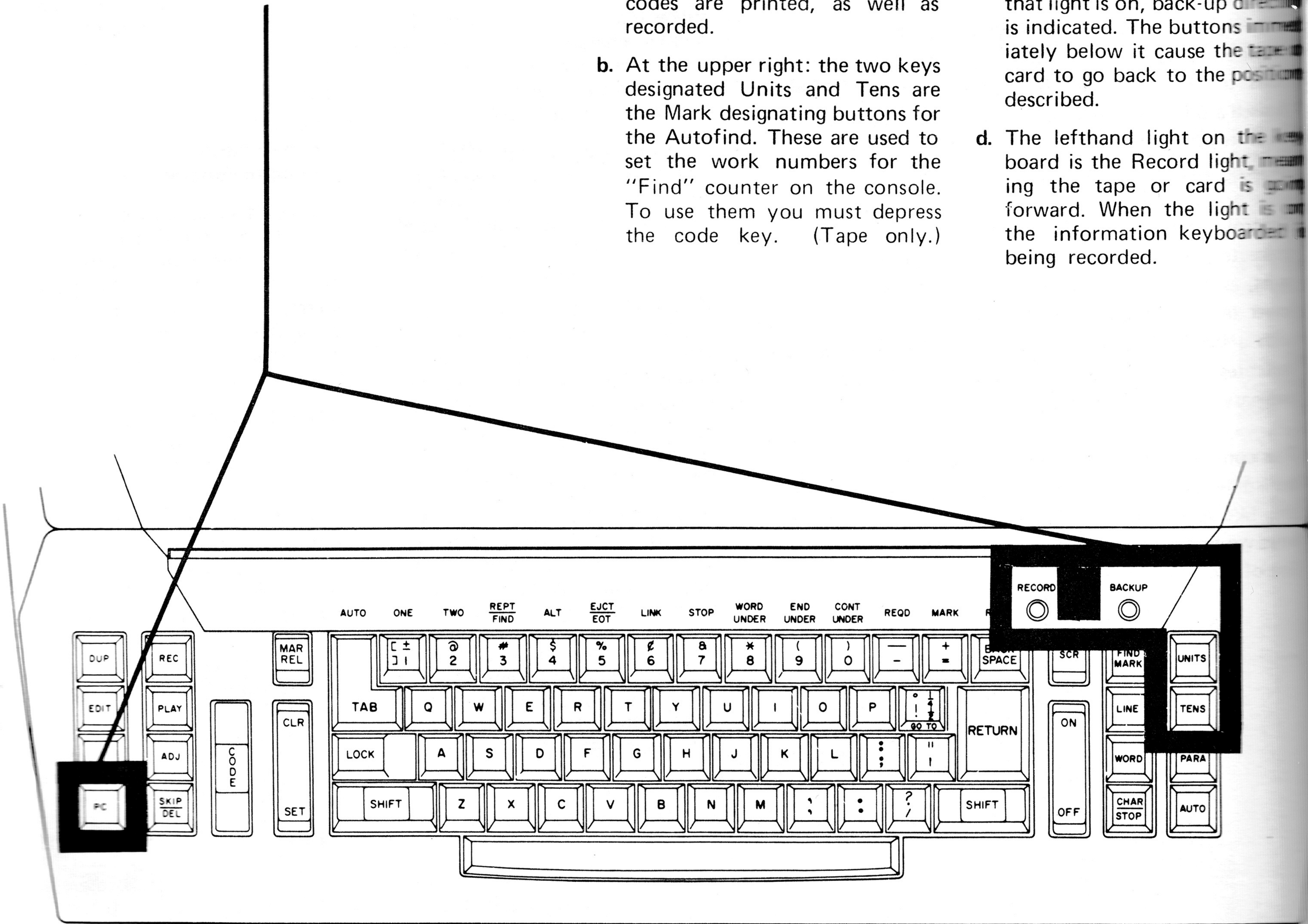
GROUP 4.
ADDITIONAL KEYBOARD INDICATORS.

a. At the lower left: the print control, determines whether the codes are printed, as well as recorded.

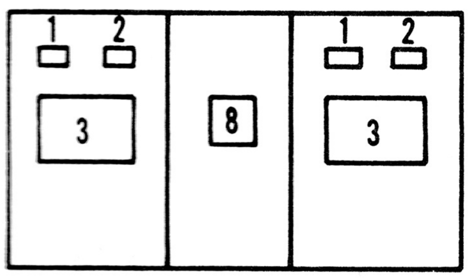
b. At the upper right: the two keys designated Units and Tens are the Mark designating buttons for the Autofind. These are used to set the work numbers for the "Find" counter on the console. To use them you must depress the code key. (Tape only.)

c. The light at the right abo keys is the Back-up light. Wh that light is on, back-up dir is indicated. The buttons imm iately below it cause the tap card to go back to the posi described.

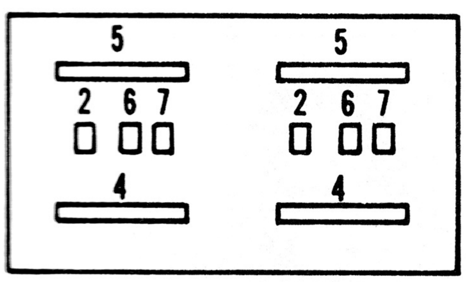
d. The lefthand light on the k board is the Record light, mea ing the tape or card is goi forward. When the light is o the information keyboarde being recorded.



CONSOLE INDICATORS:



Console – 2 cassette model



Console – 2 card model

1 Rewind	**5** Track Indicators
2 Eject	**6** Down
3 Tape Gates	**7** Up
4 Card Gates	**8** "Find" Counter Display (2 Digits)

ADDITIONAL INDICATORS ON THE CONSOLE.

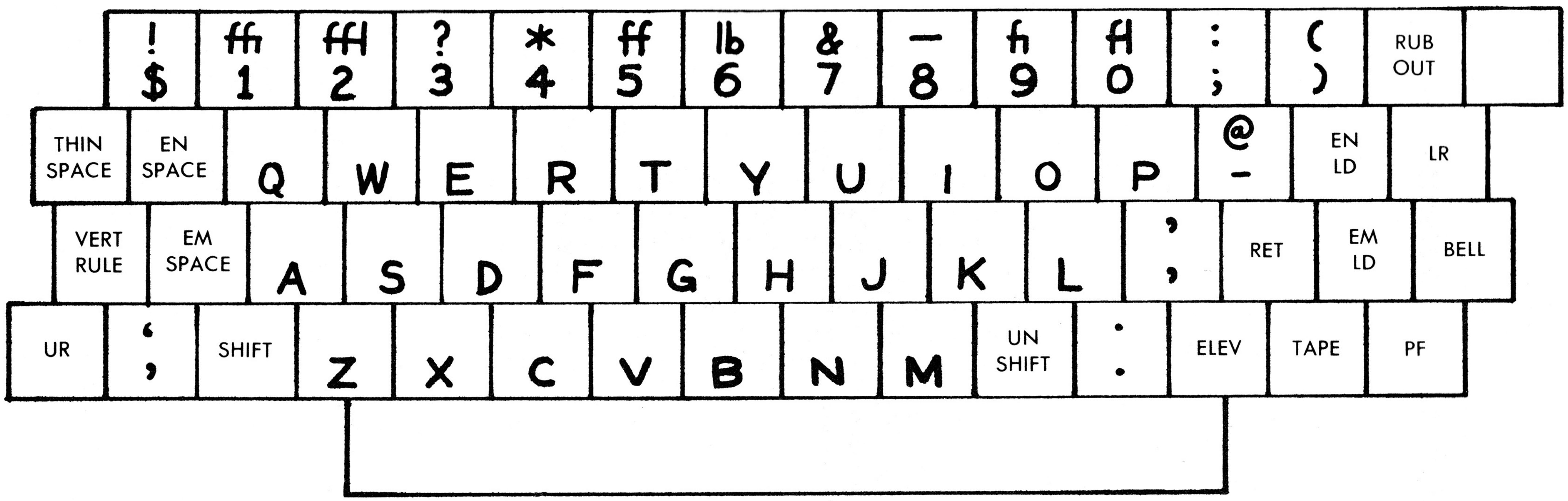
The Redactron editing typewriter (single and double car single and double tape versions) has a minimum number of controls on the console.

The card console has an indicator (for track number), and three buttons: card eject, track up and track down.

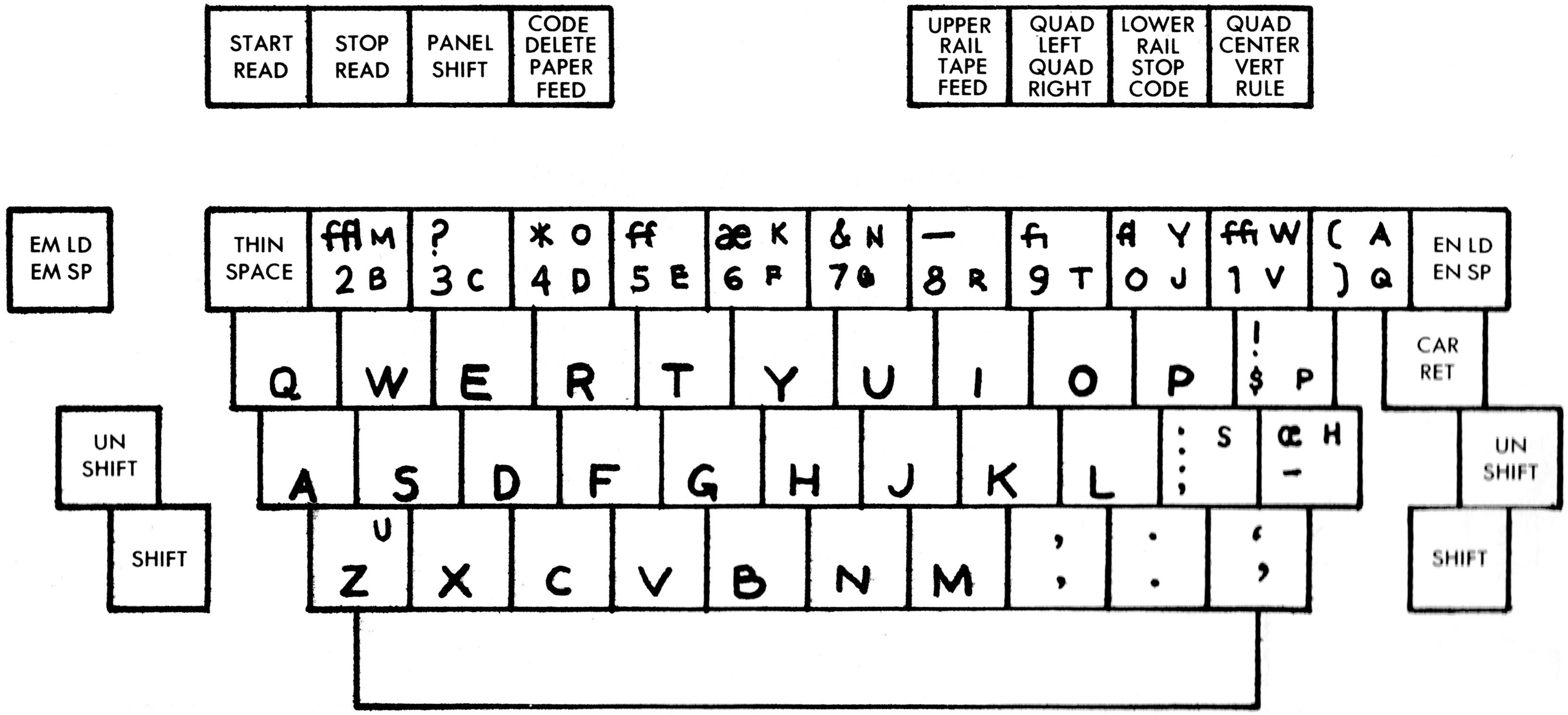
The tape version has buttons for: Rewind and Eject, and the indicator for Autofind. This is an option.

10. Keyboard arrangements

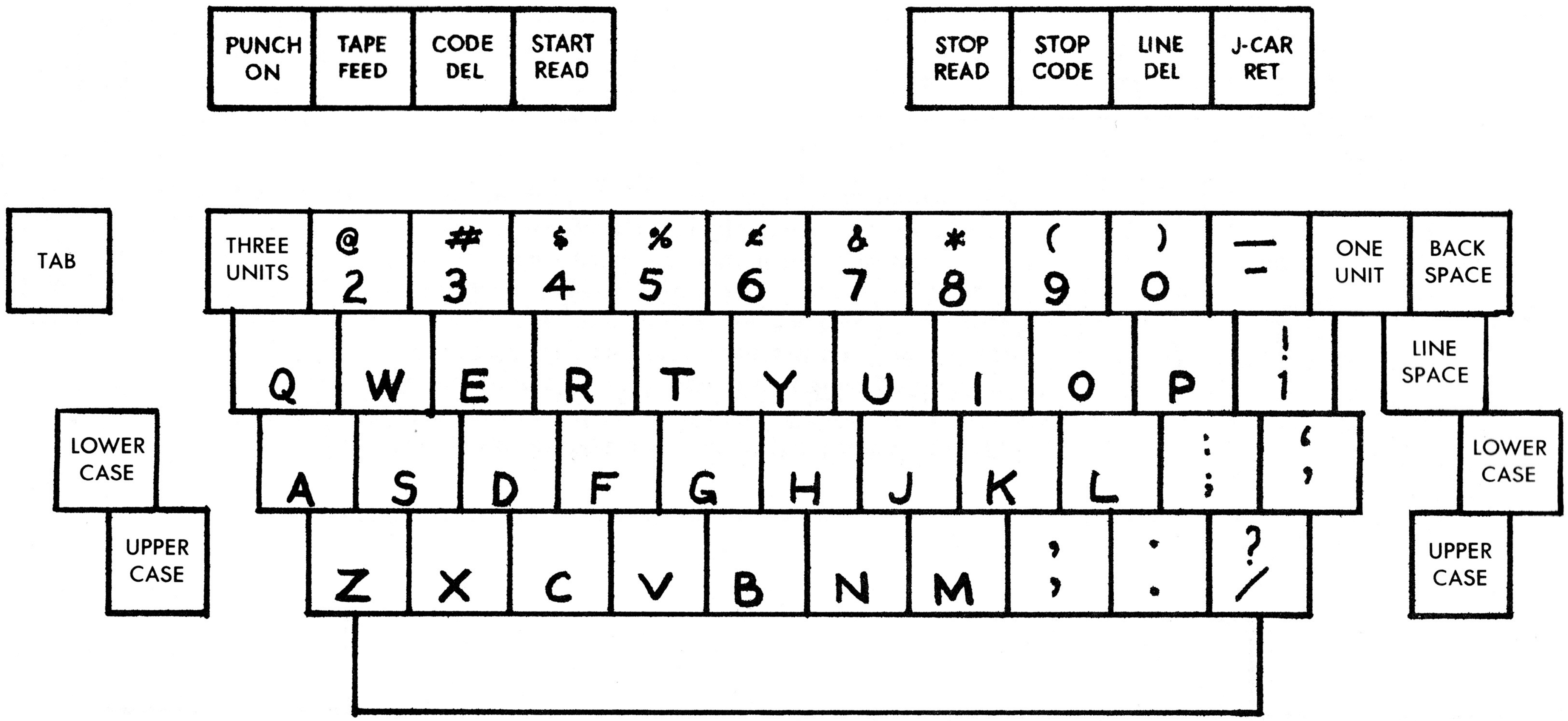
The following pages illustrate some of the keyboard layouts that are available for composition input. Detailed information on layouts and operation for specific applications may be obtained directly from the manufacturers.



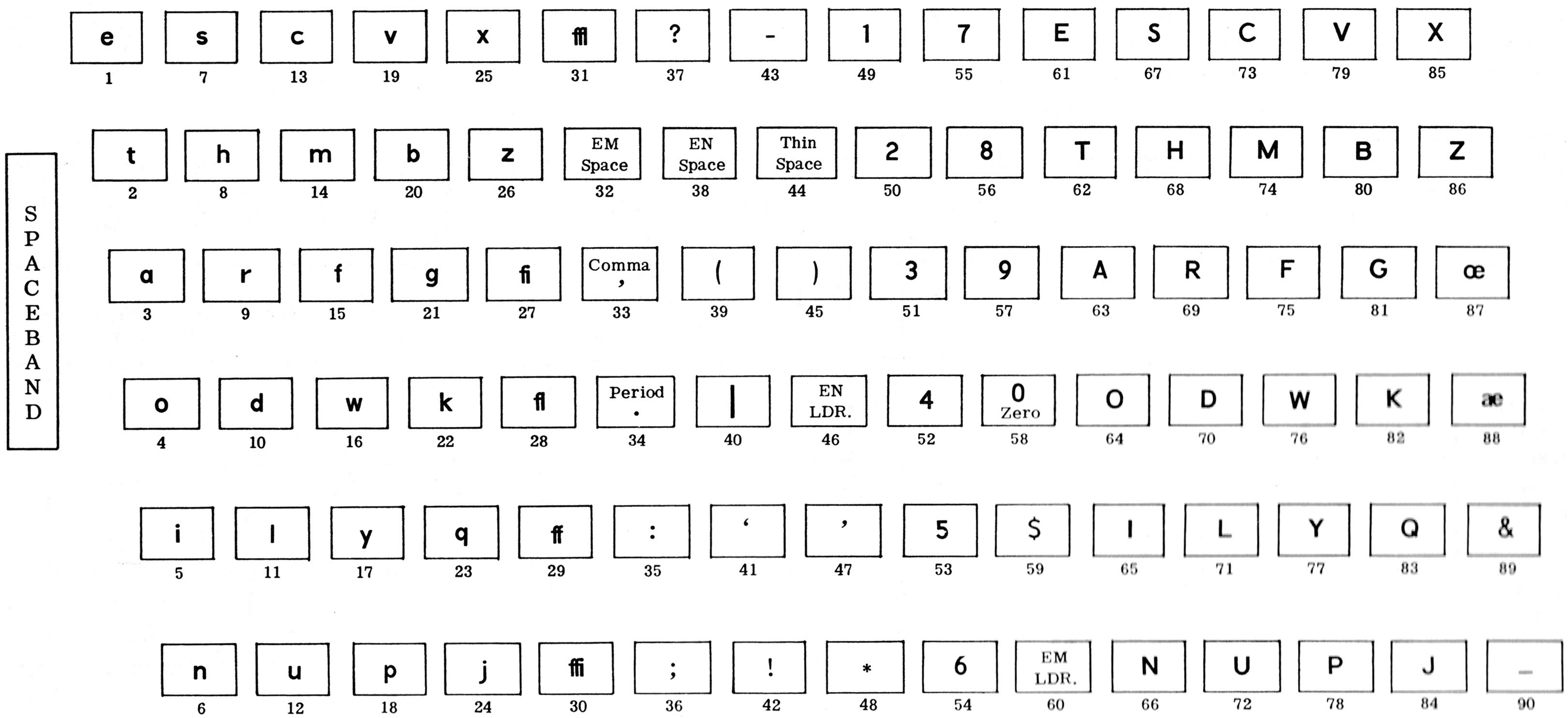
Here's the daddy of them all: the TeleTypeSetter. This is the basic layout designed specifically to drive a Linotype.



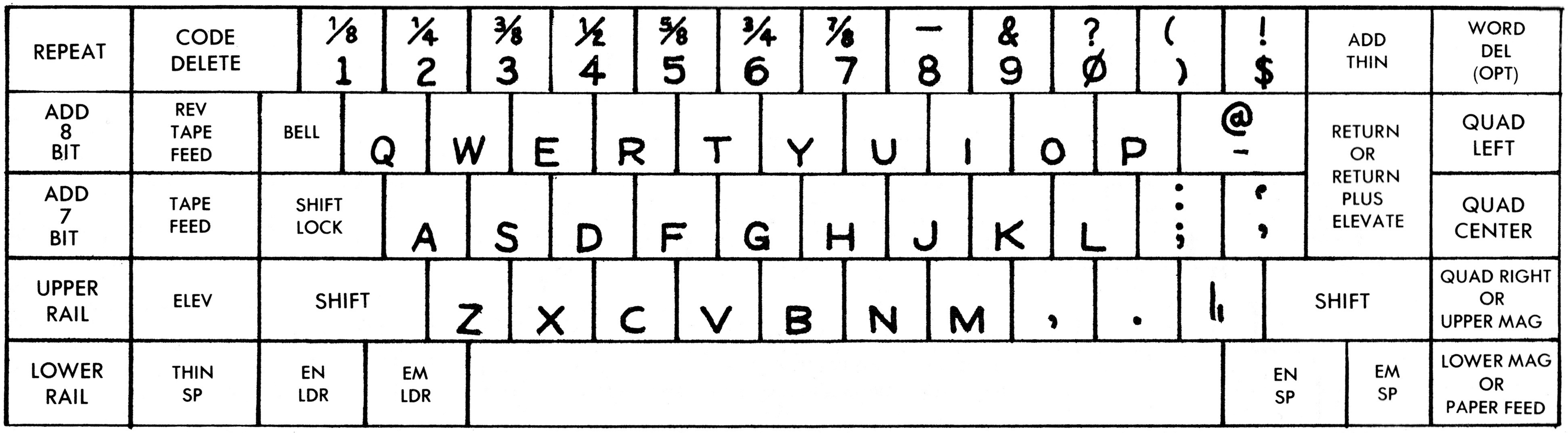
This is the keyboard layout of the Friden LCC-VF. Introduced in the late fifties, the LCC (for Line Caster Control) was designed specifically to prepare input tapes for hot metal composition. The VF version was used for non-unit-cut typefaces. The "feel" of the LCC keyboard was very close to that of the Linotype. This particular layout includes small caps. There are still quite a few LCCs around, and at used equipment prices, they can do a satisfactory input job.



The Justowriter was (and for many users still is) a very popular direct impression typesetting system. Input tapes with appropriate justification codes were prepared on the Recorder unit (layout shown) and fed into the Reproducer unit for actual typesetting. The layout utilized a standard typewriter layout with distinct shift (upper case) and unshift (lower case) keys. Every line had to end with a "J-Car Return" as tapes were being prepared.

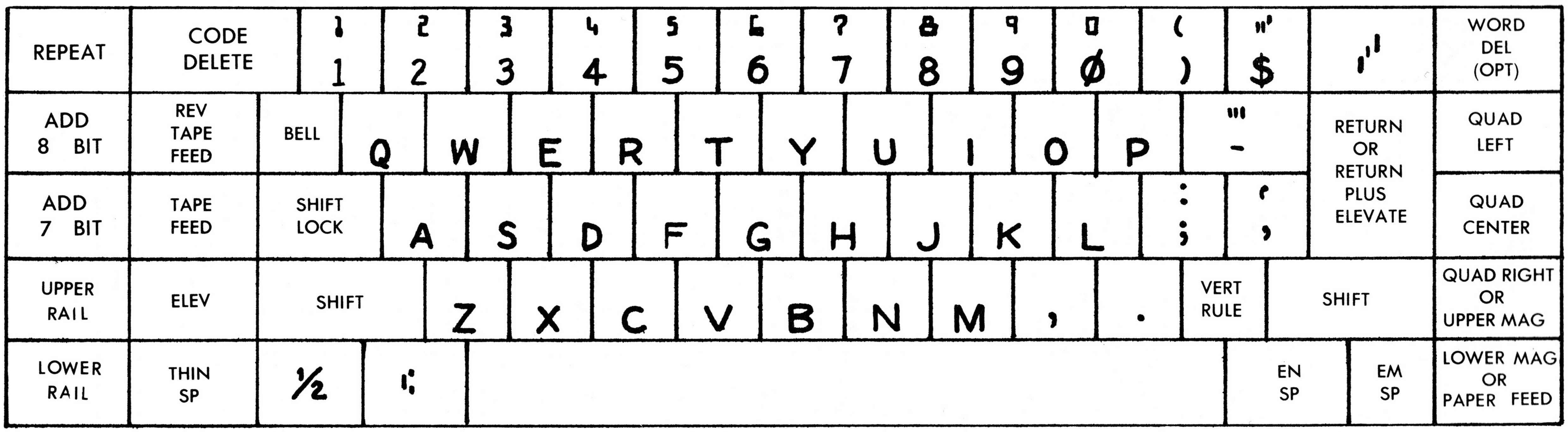


The Linotype keyboard arrangement. Linotype layouts could also be varied to match the character in a particular channel of the magazine. This is the standard arrangement.


REPEAT
CODE DELETE
1/8 1
1/4 2
3/8 3
1/2 4
5/8 5
3/4 6
7/8 7
— 8
& 9
? Ø
( )
! $
ADD THIN
WORD DEL (OPT)
ADD 8 BIT
REV TAPE FEED
BELL
Q W E R T Y U I O P
@ –
RETURN OR RETURN PLUS ELEVATE
QUAD LEFT
ADD 7 BIT
TAPE FEED
SHIFT LOCK
A S D F G H J K L
: ;
' ,
QUAD CENTER
UPPER RAIL
ELEV
SHIFT
Z X C V B N M , .
SHIFT
QUAD RIGHT OR UPPER MAG
LOWER RAIL
THIN SP
EN LDR
EM LDR
EN SP
EM SP
LOWER MAG OR PAPER FEED

One

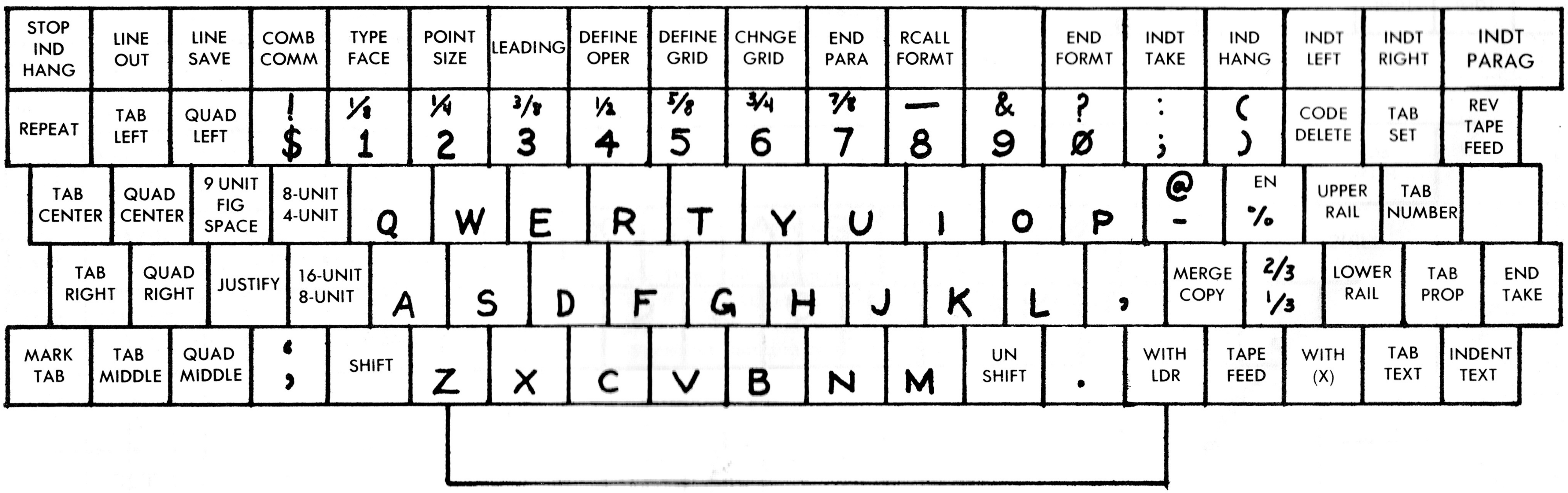
Two

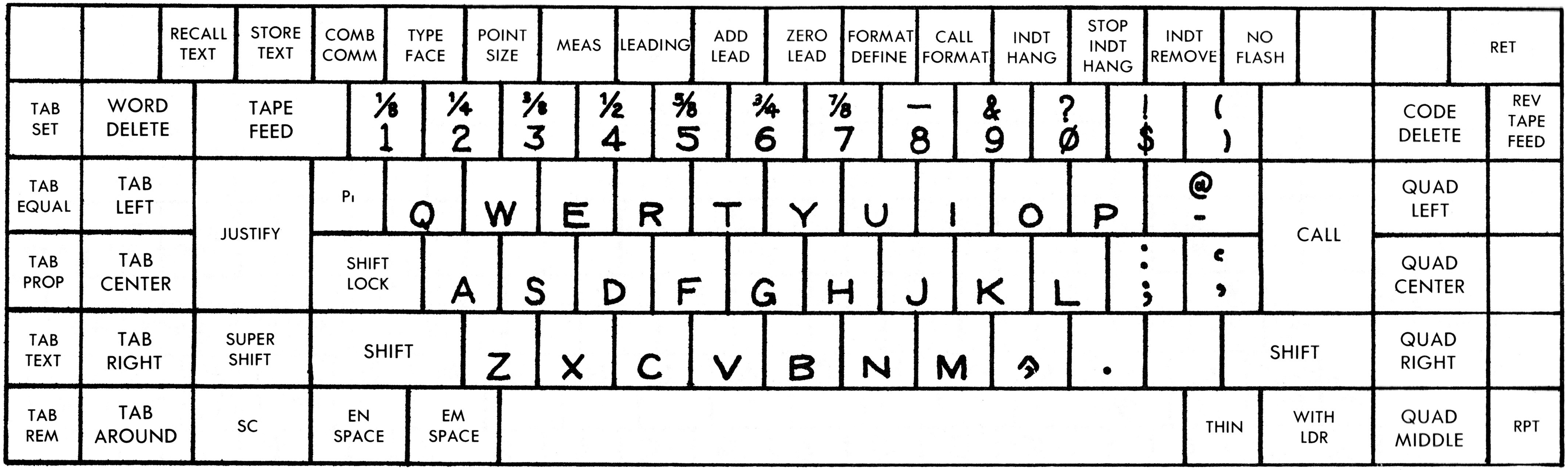

REPEAT
CODE DELETE
1 2 3 4 5 6 7 8 9 Ø
( )
$
WORD DEL (OPT)
ADD 8 BIT
REV TAPE FEED
BELL
Q W E R T Y U I O P
–
RETURN OR RETURN PLUS ELEVATE
QUAD LEFT
ADD 7 BIT
TAPE FEED
SHIFT LOCK
A S D F G H J K L
: ;
' ,
QUAD CENTER
UPPER RAIL
ELEV
SHIFT
Z X C V B N M , .
VERT RULE
SHIFT
QUAD RIGHT OR UPPER MAG
LOWER RAIL
THIN SP
1/2
EN SP
EM SP
LOWER MAG OR PAPER FEED

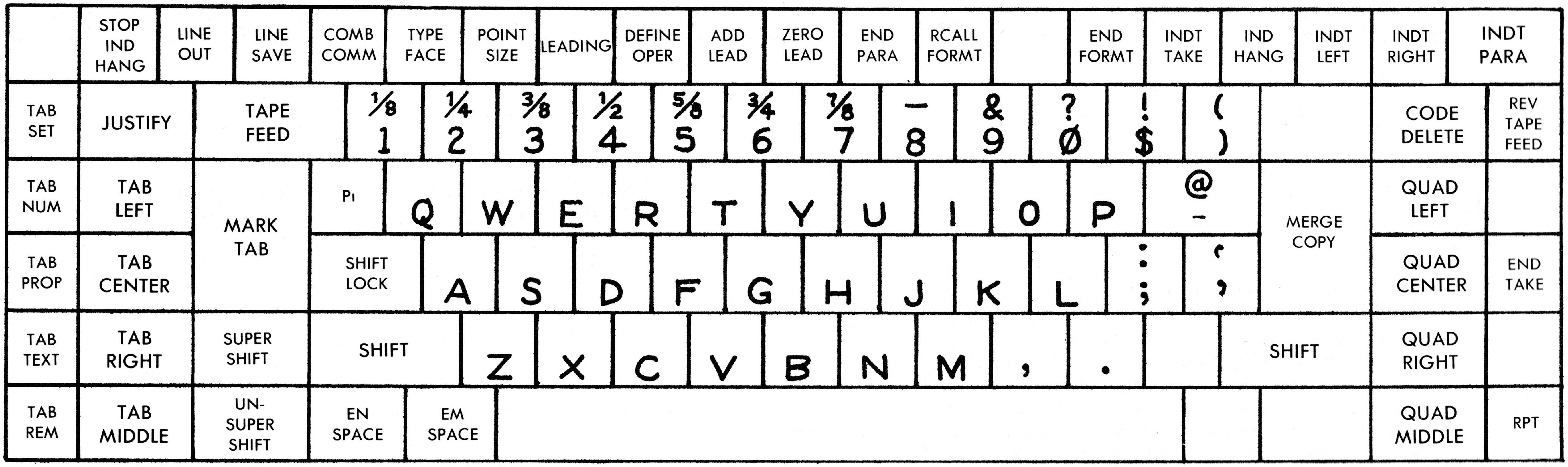
Above Here are two layouts tailored to a specific computer and a specific typesetter. Number One is the CIM-100 from Automix with the layout to run a Photon typesetter via a PDP-8 computer. Its a secretarial shift. Number Two is the same keyboard designed to drive a Photon typesetter via an IBM 1130 computer. The benefit of this "tailoring" is obvious: training is simplified and, because multiple keystrokes are avoided, errors are reduced.

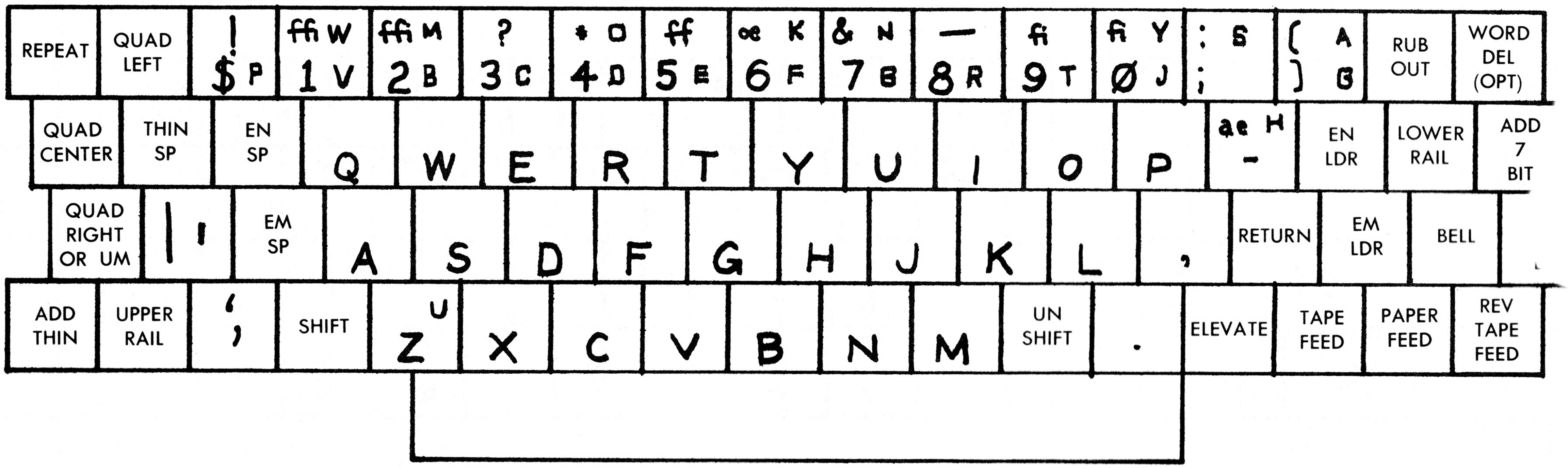
This version of the CIM-100 is a TTS keyboard layout (distinct shift and unshift keys) designed to run the Mergenthaler Linofilm via an IBM 1130.

Below



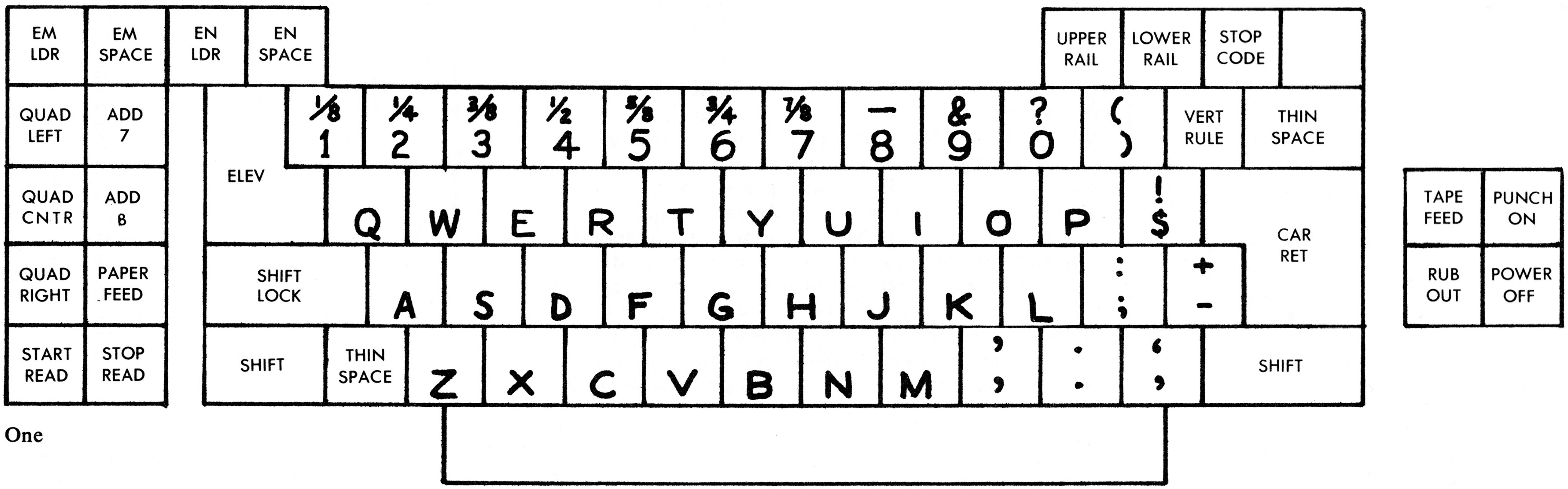

RECALL TEXT
STORE TEXT
COMB COMM
TYPE FACE
POINT SIZE
MEAS
LEADING
ADD LEAD
ZERO LEAD
FORMAT DEFINE
CALL FORMAT
INDT HANG
STOP INDT HANG
INDT REMOVE
NO FLASH
RET
TAB SET
WORD DELETE
TAPE FEED
⅛ 1
¼ 2
⅜ 3
½ 4
⅝ 5
¾ 6
⅞ 7
— 8
& 9
? Ø
! $
( )
CODE DELETE
REV TAPE FEED
TAB EQUAL
TAB LEFT
JUSTIFY
P1
Q W E R T Y U I O P
@ -
CALL
QUAD LEFT
TAB PROP
TAB CENTER
SHIFT LOCK
A S D F G H J K L
: ;
' ,
QUAD CENTER
TAB TEXT
TAB RIGHT
SUPER SHIFT
SHIFT
Z X C V B N M
.
SHIFT
QUAD RIGHT
TAB REM
TAB AROUND
SC
EN SPACE
EM SPACE
THIN
WITH LDR
QUAD MIDDLE
RPT
One

Two

STOP IND HANG
LINE OUT
LINE SAVE
COMB COMM
TYPE FACE
POINT SIZE
LEADING
DEFINE OPER
ADD LEAD
ZERO LEAD
END PARA
RCALL FORMT
END FORMT
INDT TAKE
IND HANG
INDT LEFT
INDT RIGHT
INDT PARA
TAB SET
JUSTIFY
TAPE FEED
⅛ 1
¼ 2
⅜ 3
½ 4
⅝ 5
¾ 6
⅞ 7
— 8
& 9
? Ø
! $
( )
CODE DELETE
REV TAPE FEED
TAB NUM
TAB LEFT
MARK TAB
P1
Q W E R T Y U I O P
@ -
MERGE COPY
QUAD LEFT
TAB PROP
TAB CENTER
SHIFT LOCK
A S D F G H J K L
: ;
' ,
QUAD CENTER
END TAKE
TAB TEXT
TAB RIGHT
SUPER SHIFT
SHIFT
Z X C V B N M
,
.
SHIFT
QUAD RIGHT
TAB REM
TAB MIDDLE
UN-SUPER SHIFT
EN SPACE
EM SPACE
QUAD MIDDLE
RPT

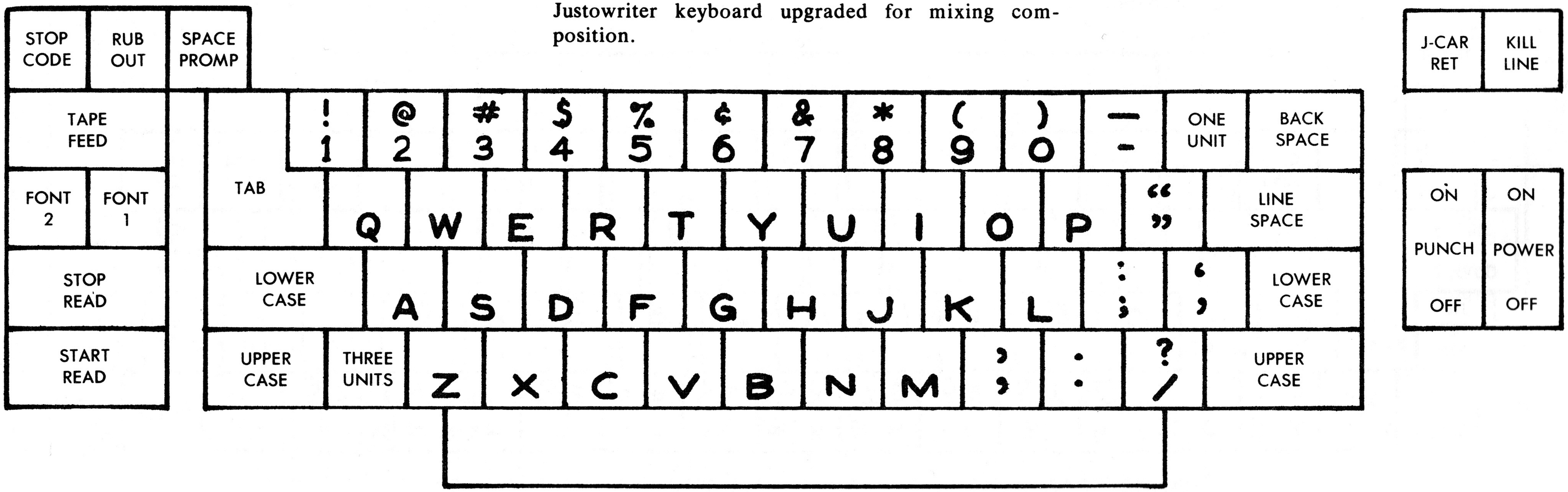


Three

These three keyboard layouts indicate the variation that is possible in arranging the keytop set. All three are from the Automite CIT-70 keyboard manufactured by Automix. Number One is a standard typewriter key set with secretarial shift plus ample typesetter function control keys to prepare unjustified input for most levels of composition. Number Two is a special layout for E13B Bank Check composition, and keytops are designated appropriately. Number Three is a TTS layout with keytops designated for commercial work (note the small caps). Thus the user can purchase one basic keyboard and tailor it to his specific needs.

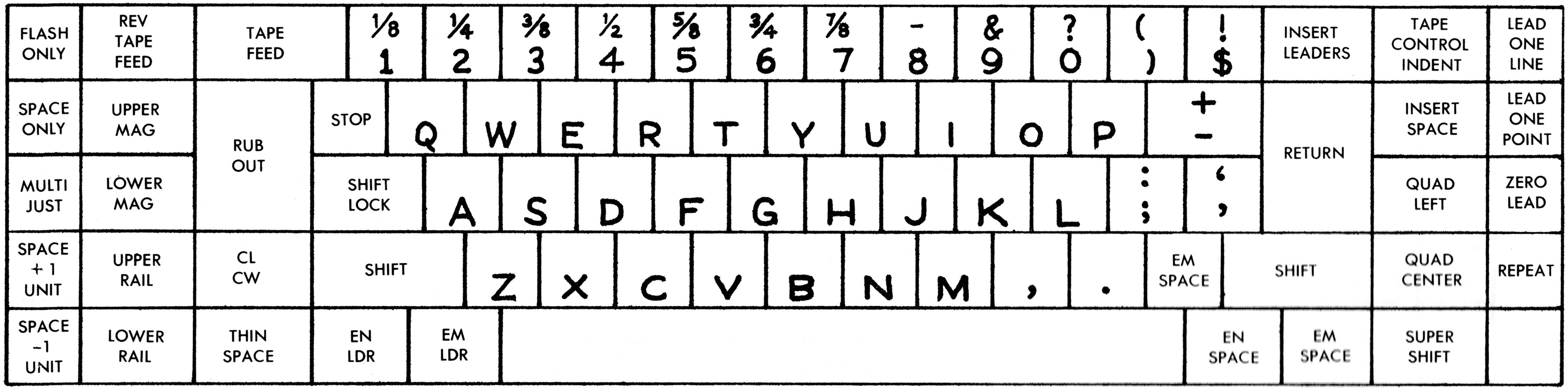


One

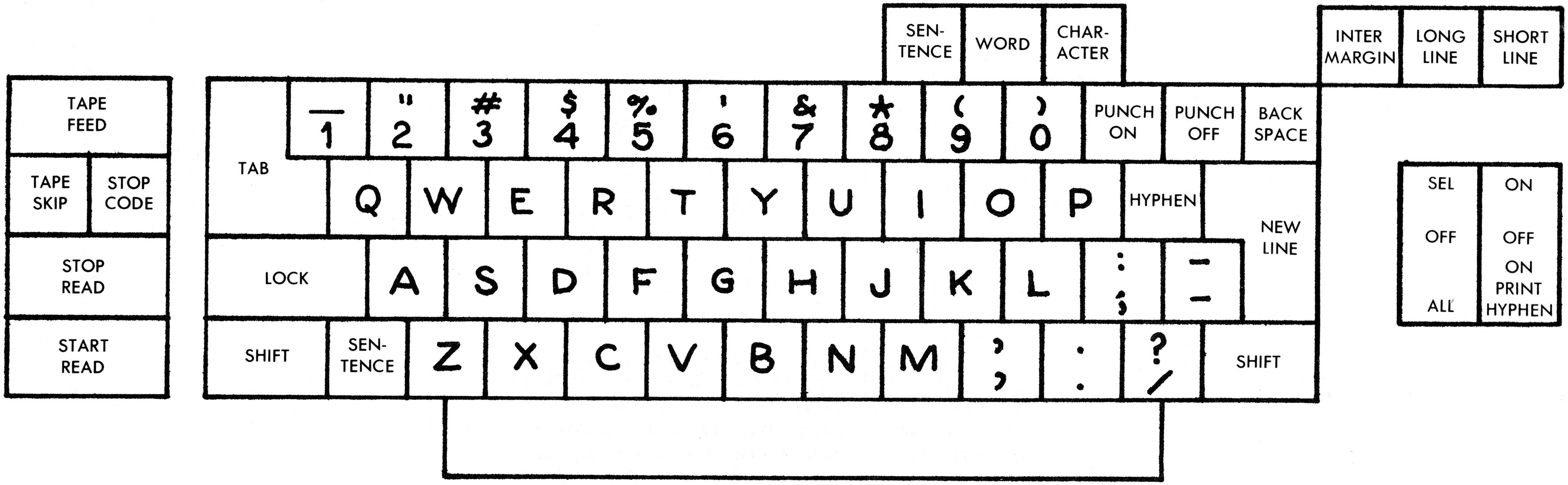


Two

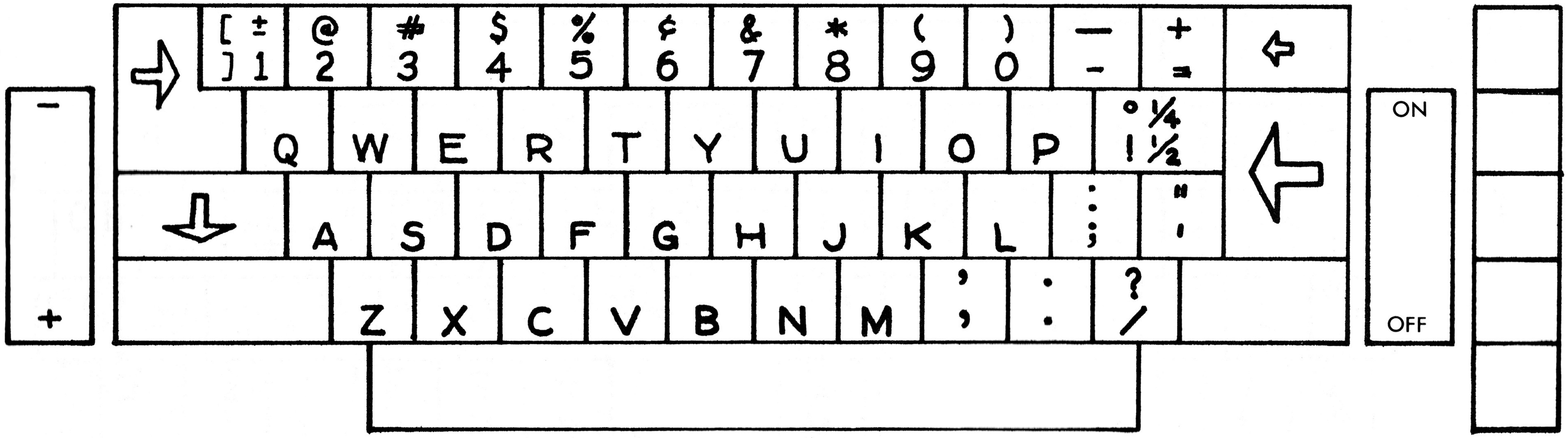
Here are two Friden keyboards, the 8202 (One) and the 8203 (Two). They are later versions of the Justowriter keyboard upgraded for mixing composition.



Compugraphic's Autotape is designed to run the CG 4961TL. Its keytop arrangement thus includes the necessary character and function keys for that specific unit. Note that the "Insert Leader" and other functions are single keystrokes. This keyboard is made for Compugraphic by Automix.

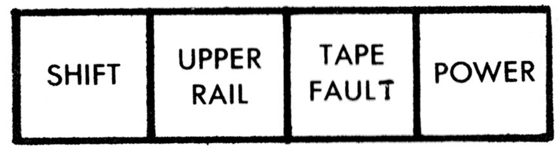


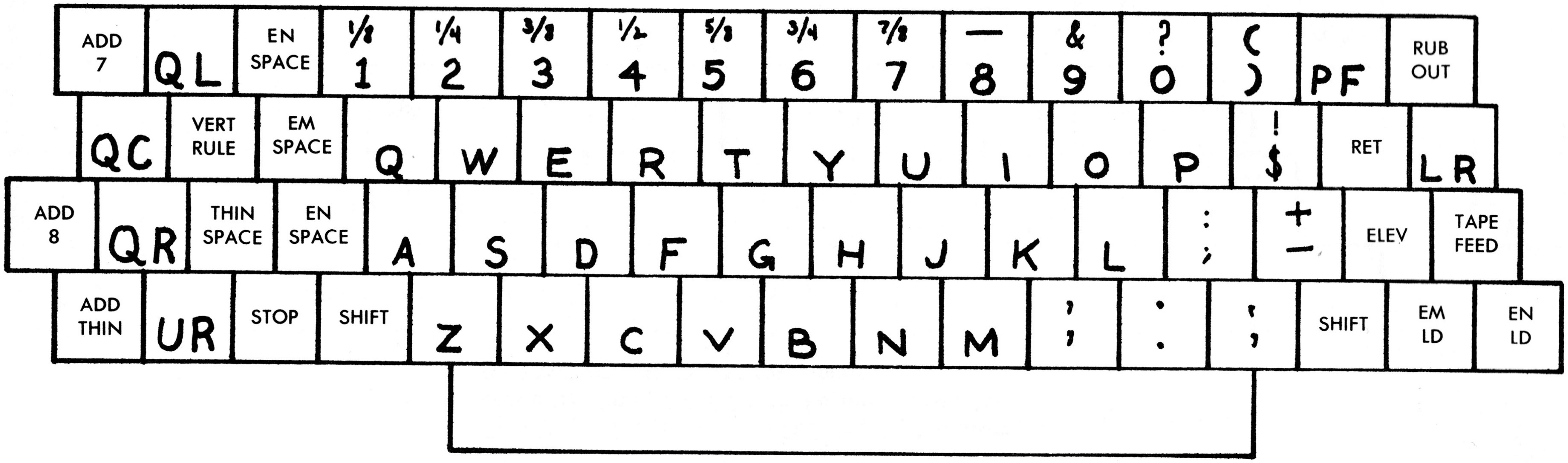
The Friden Flexowriter was one of the first "automatic typewriters." It is still used for repetitive letter writing, billing, and even composition input.



This is the layout of the ITEL Word Processor. It uses a standard IBM Selectric keyboard and adds extra keys for certain control functions.

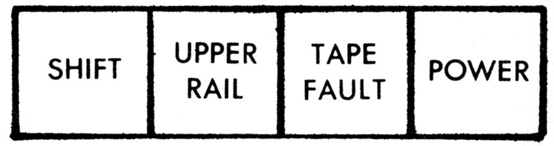
Expanded

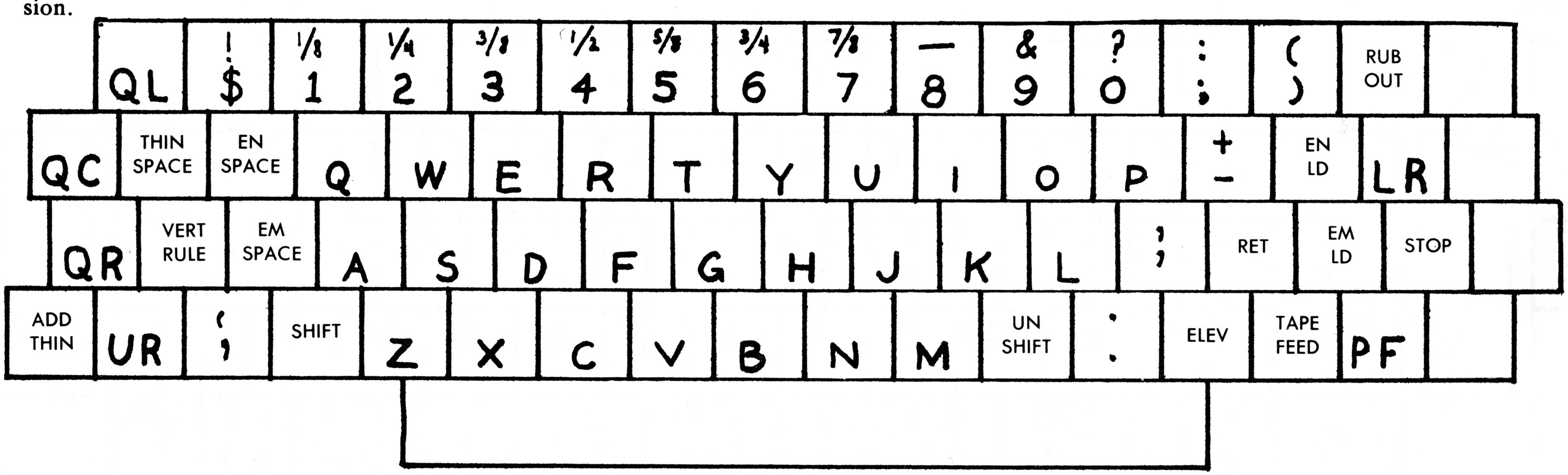


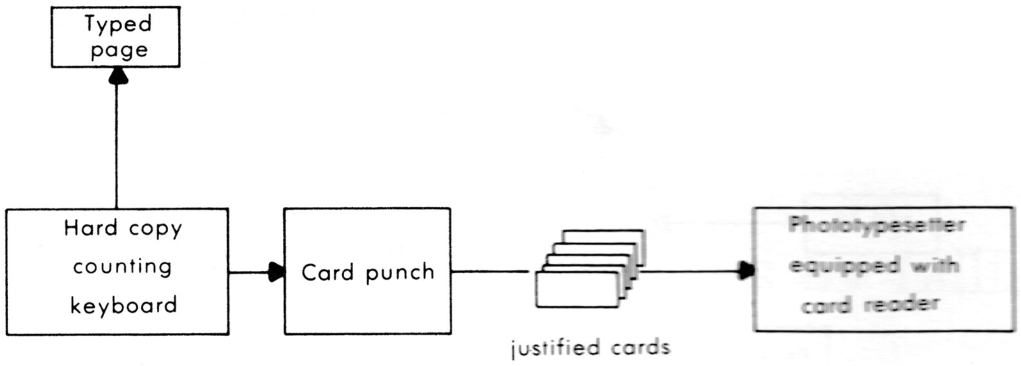


The Friden 8201 is a basic tape perforator for a degree of mixing capability (non counting). For more complex composition it comes in an expanded version.

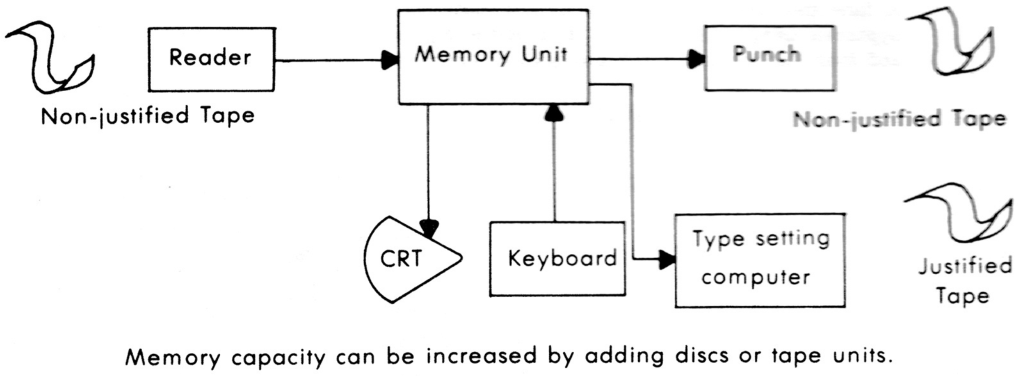
Standard



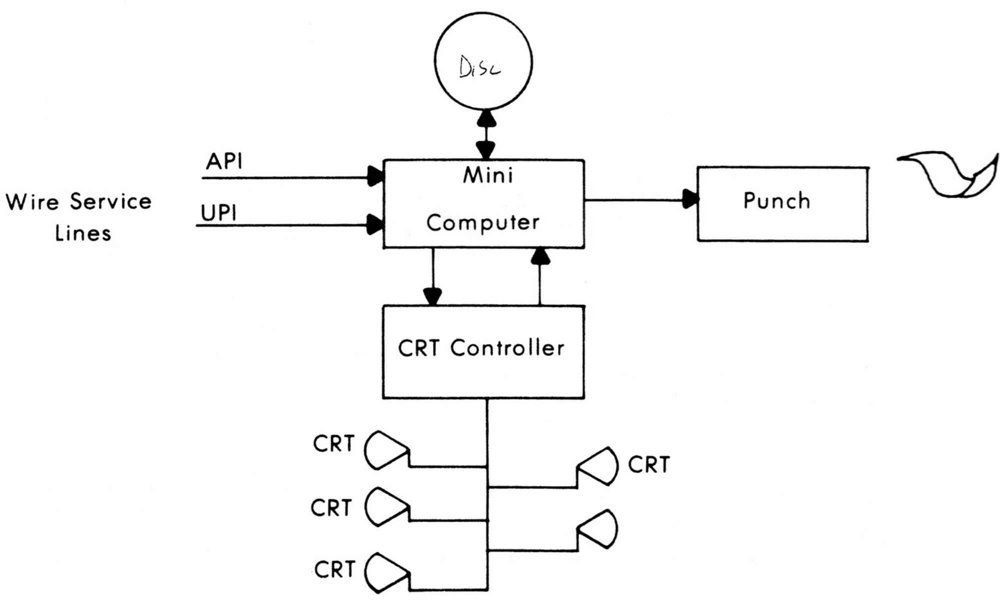




The Random Access Composition Entry system which uses punched cards as input to a phototypesetter.

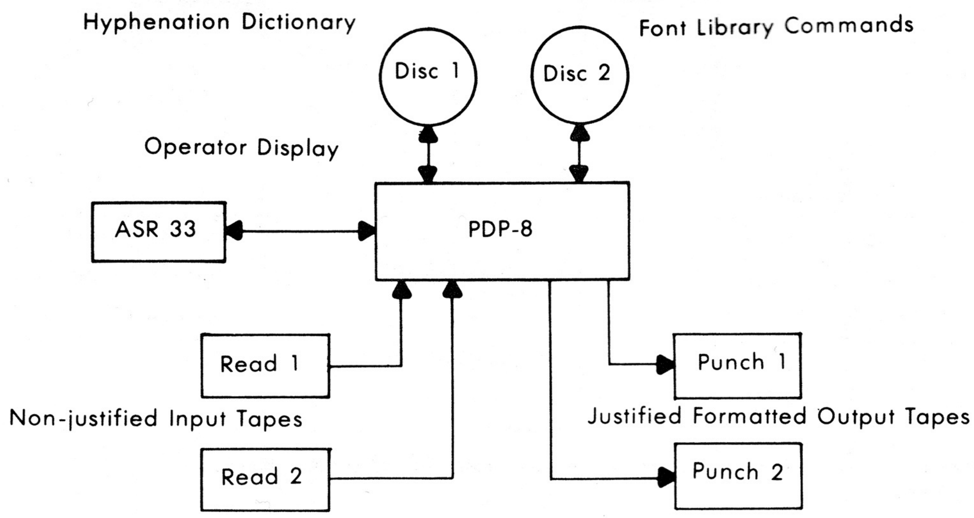


An editing system. Non-justified input is "massaged" by keyboard and video terminal and output as justified or unjustified tape.

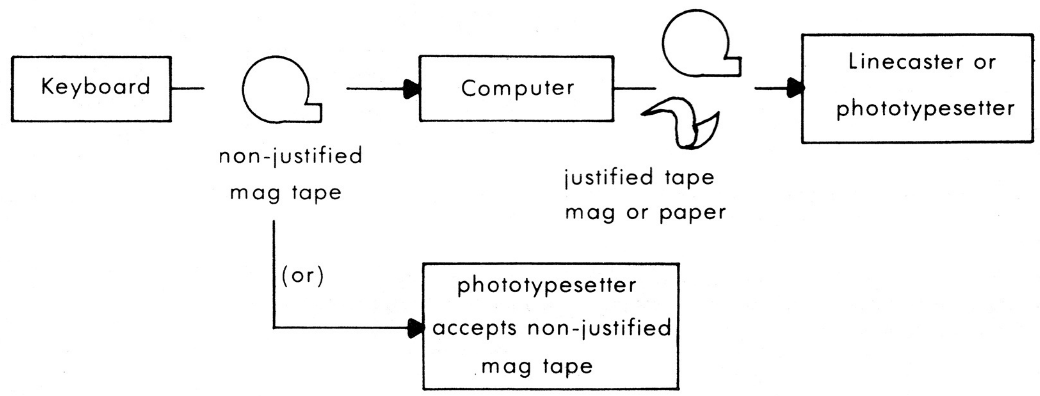


Another editing system. Wire Service input is received by a computer and allocated to one or several video terminals by a controller. After editing is completed, data is output via punch.

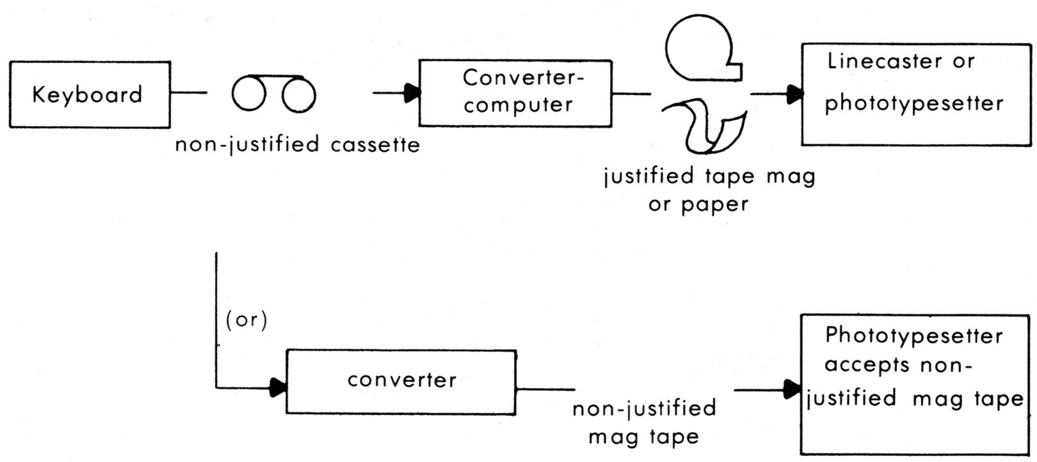
Composition input devices become part of systems.



A formatting system. Unjustified data is read into a computer with the capability to hyphenate using a dictionary and to access a large library of type font widths. Justified and formatted tapes are then produced to run a particular phototypesetter.



A magnetic tape input system.



A magnetic tape cassette input system.

Comments by Lillian Malt

A KEYBOARD FOR TEN FINGERED OPERATORS.

Why do all our keyboard designers design keyboards only for nine fingered operators? The right hand thumb is limited to the use of the space bar, and the left hand thumb is condemned to utter uselessness. The thumbs are strong and highly flexible digits. What other finger can bend so readily in its joints? The MALTRON places six keys for use under each thumb--and the increase in efficiency on the keyboard must be assessed not only by the 10 percent added finger availability, but also by the reduction of the load on other fingers.

HOW MANY FUNCTION KEYS?

The answer to this question is as many as may be accessed within the finger, hand and arm span whilst still allowing for:

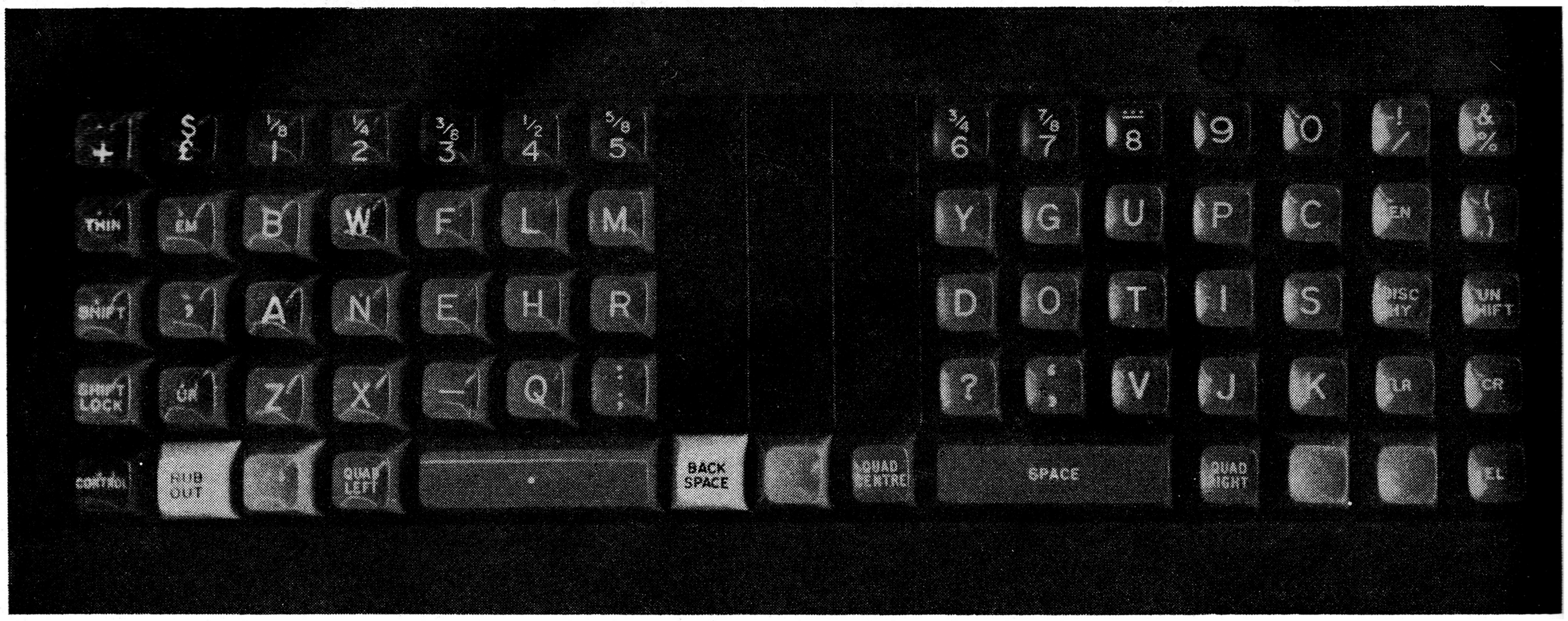
(i) head and eye movements and all other movements within their ergonomic limits

(ii) the span of kinesthetic reach and distance location

(iii) the cybernetic systems operating in language and specific keyboard function keys or command codes.

KEYBOARD DESIGN AND ALIGNMENT OF KEYS.

Let us agree that decisions regarding the design of a keyboard and the alignment of the keys should be governed by considerations relating to the greatest possible speed in operation and that in order to achieve this objective, it is essential that the human requirements for effortless and minimum movements of the fingers are provided for. Until the advent of electronic components and the solid-state circuitry the requirements of the human operator had to be subordinated within the limitations of the hardware, which is why keys on mechanical and electro-mechanical keyboards were off-set, or diagonally aligned. This is of course no longer necessary and all the research work done in ergonomics leads directly to the conclusion that the keyboard should be split, not only to allow function keys to be placed in the centre which is the best position, because of ease of and reduction in head and eye movements, but also to provide for the least expenditure of muscular energy in holding the arms in the least fatiguing and most conducive to fast digit-movement position. Ergonomically the requirement is that alpha keys for each hand should be separated by a space of at least 3 inches and more optimally by 4½ inches. Not only the findings of the ergonomists, but simple visual examination of the difficulties of finger stretches on the conventional diagonally aligned keyboards confirm this, whilst analysis of errors in keyboarding shows a clear relationship of error patterns to these difficult stretches and argues directly for vertically aligned key placement.



Maltron Keyboard Layout

PLACEMENT OF CHARACTERS ON KEYS. THREE GOVERNING FACTORS.

There is of course general agreement that the arrangement of alpha letters on a keyboard should allow for the highest speed, and so everyone agrees that the alpha letters should be located to the keys in such a manner that the most frequently struck letters will be most directly, therefore quickly and easily, accessed by the fingers. Various keyboard layouts have been designed with this in mind, e.g. MALTRON, DSK (Dvorak) and the lesser known Lundgren and Hoke. Statistically all these keyboards have much greater validity than Sholes in providing for faster operation, and although the MALTRON is statistically superior to any of the others, there is not a great deal of difference between them. Hoke is considered inferior to the others because it has 7 of the 100 commonest digrams on the same finger. However, a letter arrangement which only allows for speed through reducing the distance travelled by the fingers, is not the optimum arrangement. Two other factors must be considered--they are the extra speed which can be obtained through lateral keystroking, referred to in the article as "chording," and the reduction of errors through a consideration of the cybernetics of language.

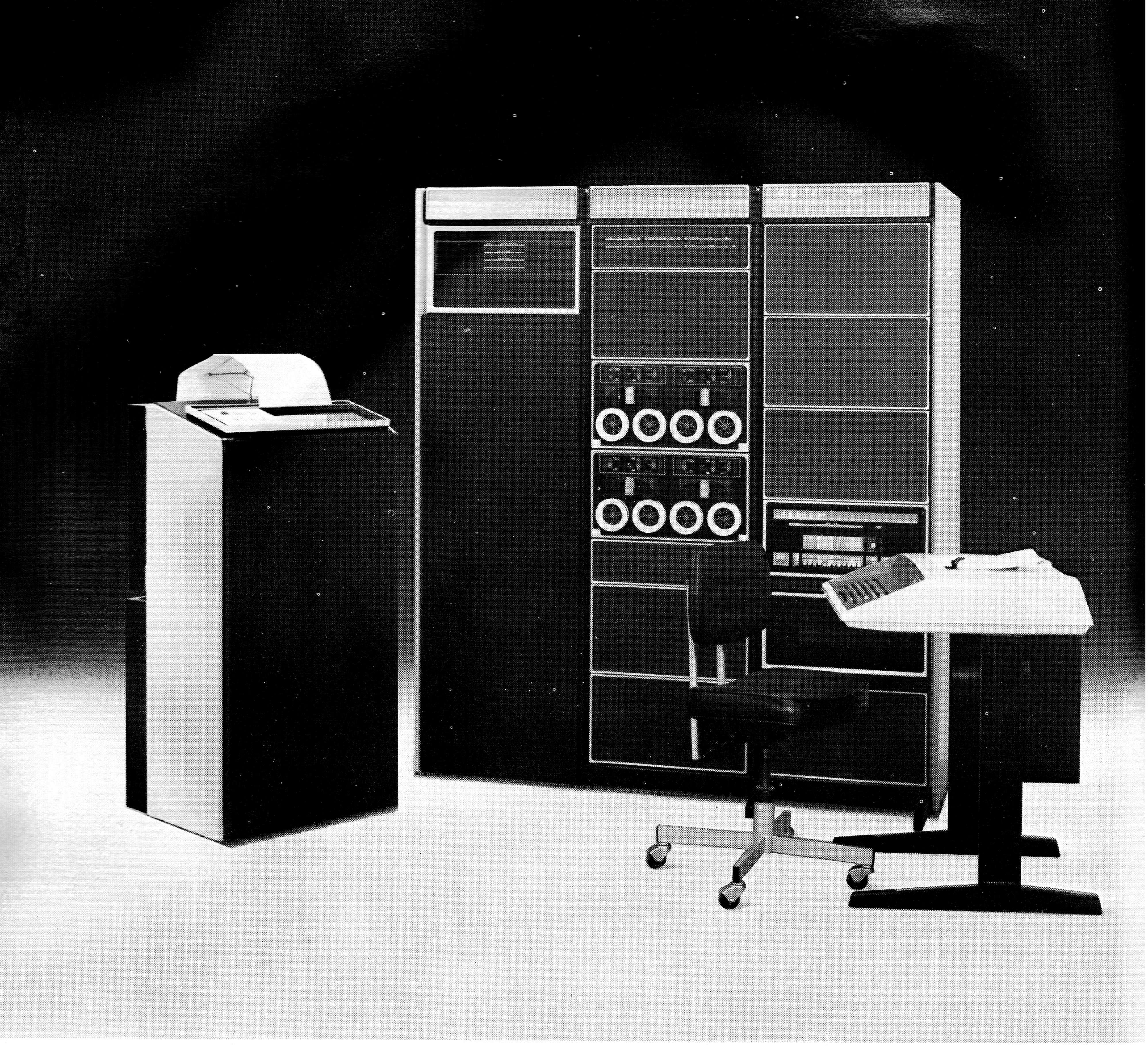
LOADING OF HANDS AND FINGERS.

Not only should alpha letters be so placed so that the keystroke workload is evenly balanced between both hands, but also that each finger should be optimally loaded allowing for flexibility potential related to muscular movement possibilities and position within the finger framework.

It is very important to make the distinction that "the right hand is generally more flexible and stronger than the left" at the commencement of training. With good training the left hand acquires a dexterity equal to that of the right hand and that is why the workload should be balanced.

The little fingers of either hand are very flexible and strong enough for keying on electronic machines. Therefore they can take the workload of alpha characters together with extraneous and function keys placed within easy reach of the home keys. This makes it possible to place shift keys to the left and right along the home row, and this is the best position for quick and easy reach without excessive stretch which is so very important with function keys used as frequently as the shift keys. The secretary shift does save keystrokes.

The ring fingers of both hands do not have the muscular movement possibilities nor the capacity for strength that the other fingers have because the anatomical muscular system has the little and ring fingers sharing a single muscle complex, and of course the ring fingers are further prescribed because of their position within the digital framework.



This is the computer that can do your news, or your classified, or your advertising, or your accounting.

Typeset-8.
The computerized typesetting system over 300 newspapers are using.
Because it automatically hyphenates and justifies copy.
Because it can work on both hot metal and photo composition machines.
Because it's fast. Reliable.
Because it has a business systems package that can do all the accounting.

Because prices start at under $12,000.
And because it made a big job small.
Still, some people wanted even more.
So here it is.

Introducing Typeset-11.
It can do everything Typeset-8 can do and more. All at the same time.
And faster.

Typeset-11 can do your news, classified, and advertising from all types of input: OCR, visual display terminal (VDT), on-line keyboards or paper tape.

It keeps track of everything. Automatically hyphenates and justifies all your type whatever way you want. Then sends it straight to your photocomp machines, line printers, visual display terminals. Or you can put it on magtape. Or paper tape.

Here's all the print that's fit for news. And fit for a lot of other things, too.

Meet your winning news team. The Electro/Set 430 perforating keyboard and the AM 744 phototypesetter.

They also double as admakers and job workers. And, therefore, as money-makers for you.

With the versatile new AM 744 phototypesetter you can print the news *fast.* 50 lines a minute.

Type comes in 5 to 36 point sizes. And the 744 handles four type faces, in four sizes, at a time. Changes only take one minute. Just one.

And, most important, the 744 also lets you get into other kinds of work. Ad guts. Job printing. With quality as high as specialized machines provide. You won't find anything as flexible in its price range.

Couple the 744 with the Electro/Set 430 perforating keyboard and you've got perfect teamwork.

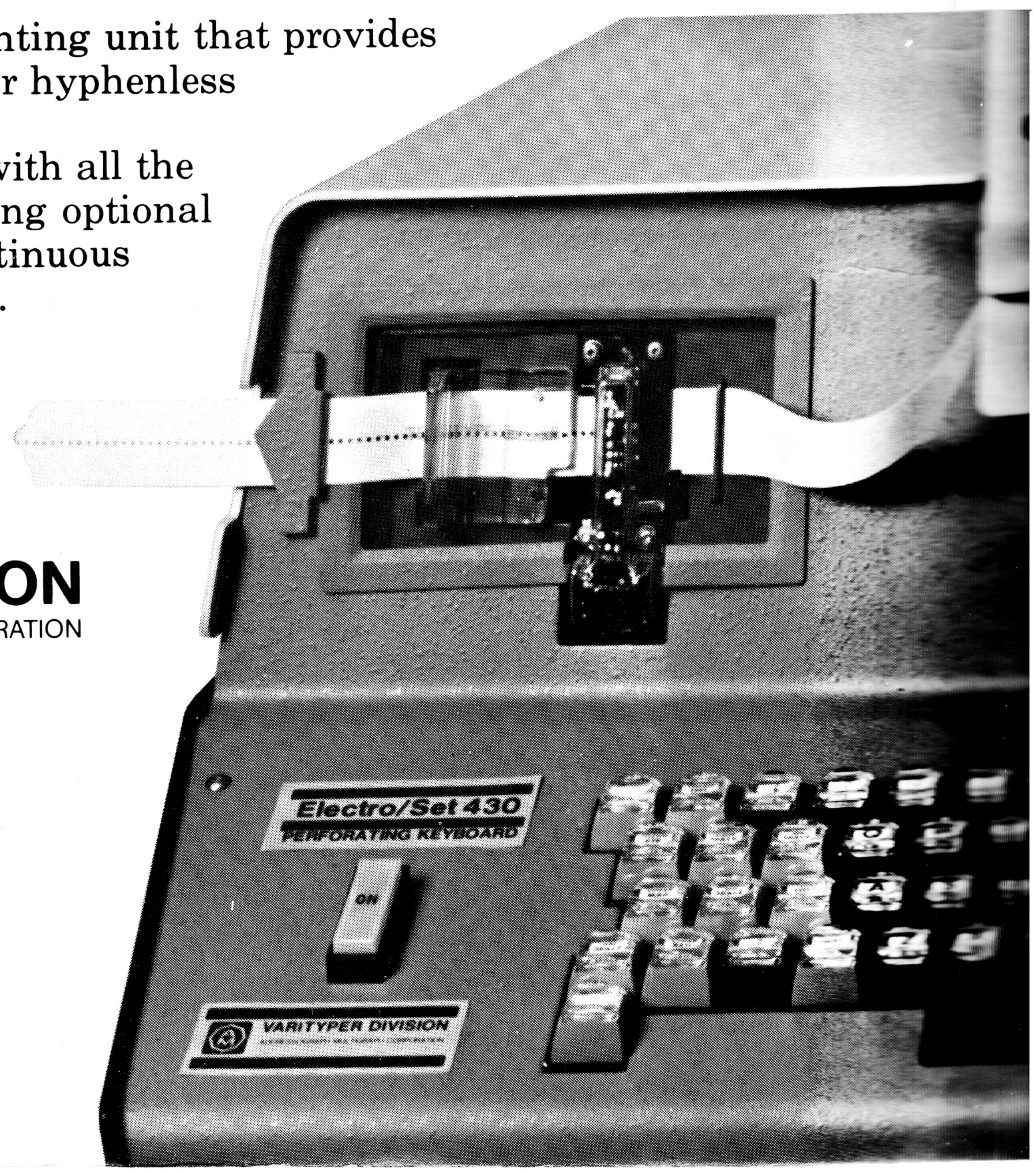
The 430 is a blind/non-counting unit that provides simplified, very high speed input for hyphenless justification.

It is completely electronic, with all the auxiliary controls you need. Including optional visual display that shows, on a continuous strip, the last 64 characters pressed.

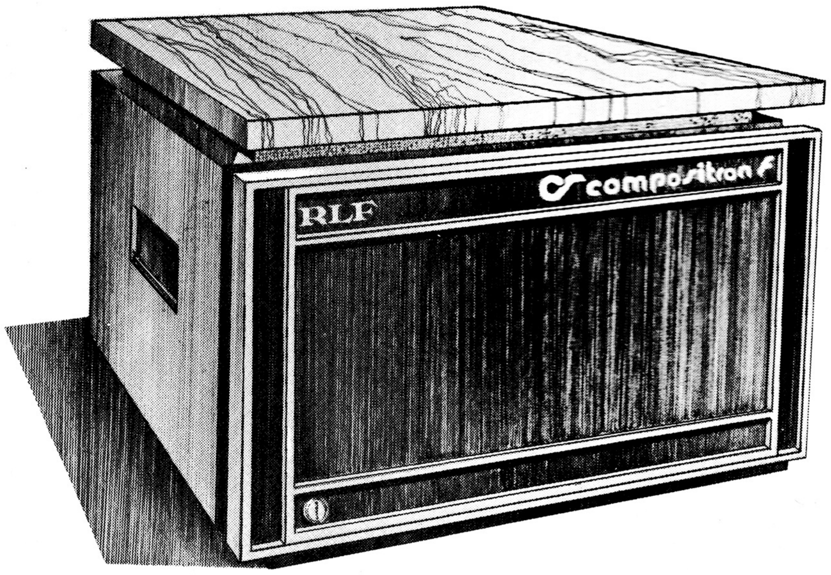
Be sure to see the AM 744 and the Electro/Set 430.

They not only get out the news, they bring in the extras.

VARITYPER DIVISION
ADDRESSOGRAPH-MULTIGRAPH CORPORATION
BOX 3176, CLEVELAND, OHIO 44117



Go to bed with us and save money.



Is your composing room in a panic everytime you put the paper to bed? Display ads. Classified update. Late news copy. Corrections and changes. Headlines. Stock quotes. Your two best keyboard operators are both out. Deadlines don't wait.

You know that a phototypesetting computer would format your display ads faster, store and update your clasisfied ads and stock quotes with ease, set your headlines from "idoit tape," and all with office typists, or your secretary if need be. But can you afford a computer?

You can. If it's an RLF Enterprises Compositron. It will do anything that computers costing three to five times as much will. One Compositron can time-share schedule your composed-format text into up to ten phototypesetters at a time. Even if they are of different makes. Ordinary typists at simple keyboards can set complicated grocery ads, sports statistics, or newspaper text. All style and format changes are keyboard controlled by easily remembered simple keystrokes. The Compositron does the rest! Hyphenation, homographing, tabbing up to 15 columns, variable column cutting, and just about anything else you (or we) can think of. It also accepts wire-service tape modes, stock market data, and teletype paper tapes directly. Direct connection of the Compositron to the phototypesetter lets you transmit typesetting via teletype wire to a branch office machine anywhere.

The Compositron designed expressly for newspaper and directory services is called Model FC. It is the same as the standard Model F, but has added a disk storage unit with a capacity for about the usual Sunday Los Angeles Times classified section. This unit is tailored for repeat applications such as classified text settings, directories, and name and address lists, as well as regular text and ad setting. Any information that needs periodic update can be stored, called back, changed, set, and stored again. Video terminals, optical character readers, and magnetic tape inputs and readers can also be used with the Compositron FC. Included in the price of the Compositron is the training given to your operator right in your shop.

The cost? Here is where the Compositron really shines. The Model FC costs under $40,000; the Model F under $25,000. You can lease or buy.

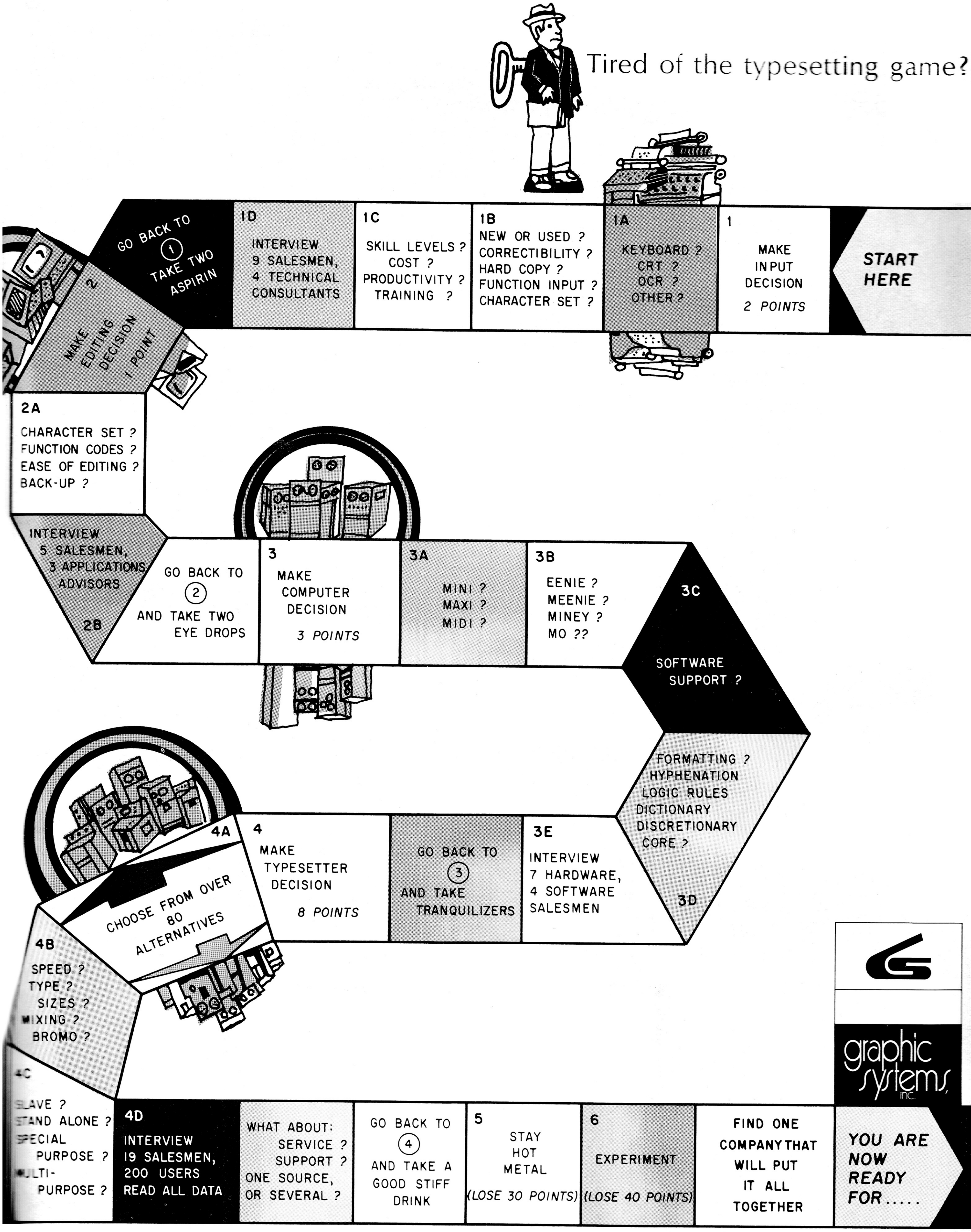
In most composing rooms, either Compositron will pay for itself in the first year, even if you only have a single phototypesetter.

For years, RLF Enterprises has serviced phototypesetters and created sophisticated auxiliary hardware for them. We know what shops need. We designed our basic software package out of this knowledge and we can also prepare additional programs to compose any of your formats from straight through "idiot" tape.

There's more to tell. We'd like to show you the benefits of having a Compositron right in *your* composing room. Call or write and we'll show you how you can put your paper to bed with us and stuff your mattress with the savings.

RLF Enterprises office is at 6261 Primrose Ave., Los Angeles, Calif. 90068 or phone (213) 464-4184.

compositron


Tired of the typesetting game?
START HERE
1
MAKE INPUT DECISION
2 POINTS
1A
KEYBOARD ? CRT ? OCR ? OTHER ?
1B
NEW OR USED ? CORRECTIBILITY ? HARD COPY ? FUNCTION INPUT ? CHARACTER SET ?
1C
SKILL LEVELS ? COST ? PRODUCTIVITY ? TRAINING ?
1D
INTERVIEW 9 SALESMEN, 4 TECHNICAL CONSULTANTS
GO BACK TO 1 TAKE TWO ASPIRIN
2
MAKE EDITING DECISION 1 POINT
2A
CHARACTER SET ? FUNCTION CODES ? EASE OF EDITING ? BACK-UP ?
INTERVIEW 5 SALESMEN, 3 APPLICATIONS ADVISORS
2B
GO BACK TO 2 AND TAKE TWO EYE DROPS
3
MAKE COMPUTER DECISION
3 POINTS
3A
MINI ? MAXI ? MIDI ?
3B
EENIE ? MEENIE ? MINEY ? MO ??
3C
SOFTWARE SUPPORT ?
FORMATTING ? HYPHENATION LOGIC RULES DICTIONARY DISCRETIONARY CORE ?
3D
3E
INTERVIEW 7 HARDWARE, 4 SOFTWARE SALESMEN
GO BACK TO 3 AND TAKE TRANQUILIZERS
4
MAKE TYPESETTER DECISION
8 POINTS
4A
CHOOSE FROM OVER 80 ALTERNATIVES
4B
SPEED ? TYPE ? SIZES ? MIXING ? BROMO ?
4C
SLAVE ? STAND ALONE ? SPECIAL PURPOSE ? MULTI-PURPOSE ?
4D
INTERVIEW 19 SALESMEN, 200 USERS READ ALL DATA
WHAT ABOUT: SERVICE ? SUPPORT ? ONE SOURCE, OR SEVERAL ?
GO BACK TO 4 AND TAKE A GOOD STIFF DRINK
5
STAY HOT METAL
(LOSE 30 POINTS)
6
EXPERIMENT
(LOSE 40 POINTS)
FIND ONE COMPANY THAT WILL PUT IT ALL TOGETHER
YOU ARE NOW READY FOR.....
graphic systems inc.

Turn here...

American Press

Credits
Cover illustration: Mergenthaler J 100 keyboard.
Title art: VGC Photo Typositor Korina Bold
Printed in U.S.A. Wayside Press, Mendota, Ill.